Universal Frequency Counters
PM 6673...76

Service Manual

9499 465 00111
820615 First edition

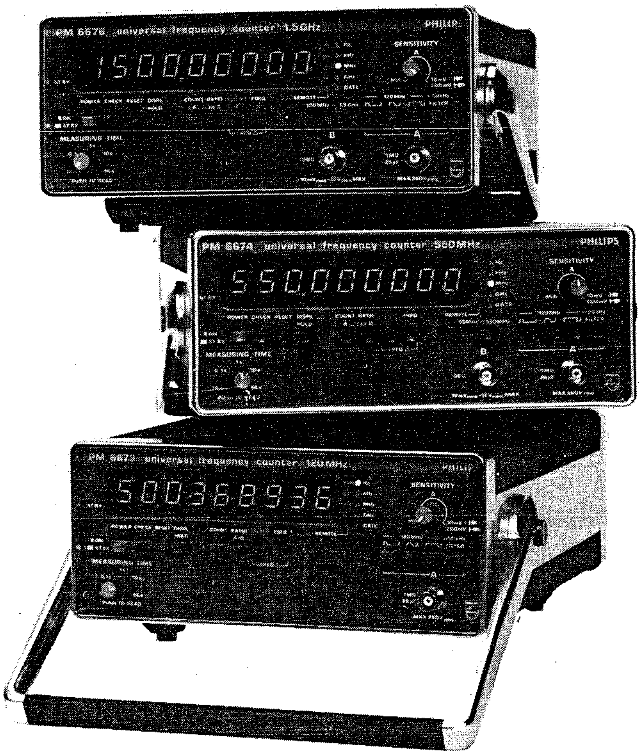
S&i
Scientific & Industrial equipment division

PHILIPS

Universal Frequency Counters
PM 6673...76

Service Manual

9499 465 00111
820615 First edition



PHILIPS

SAFETY REGULATIONS

General information

This counter has been designed and tested in accordance with IEC Publication 348, Safety Requirements For Electronic Measuring Apparatus For Class 1 Instruments, and has been supplied in a safe condition. The present manual contains information and warnings that shall be followed by the user, to ensure safe operation and to retain the counter in a safe condition.

Before connecting the counter to the line (mains), visually check the cabinet, controls, connectors, etc, to ascertain whether any damage has occurred in transit. If any defects are apparent, do not connect the counter to the line. All components on the primary side of the line transformer are CSA approved and should only be replaced with original parts.

In the event of obvious damage, missing parts or if the safety of the counter is suspected, a claim should be made to the carrier immediately. A PHILIPS Sales or Service organisation should also be notified in order to facilitate the repair of the counter.

Grounding

The counter is connected to ground via a three-core line cable, which must be plugged into a socket outlet with a protective ground contact. No other method of safety grounding is permitted for this counter. When the counter is brought from a cold to a warm environment, condensation may cause a hazardous condition. Therefore, ensure that the grounding requirements are strictly met.

Any interruption of the protective ground, inside or outside the counter is dangerous. Line extension cables must always have a protective ground conductor.

Opening of the cabinet

The counter shall be disconnected from all voltage sources before any adjustment, replacement, maintenance or repair is effected with the covers removed.

If adjustment or maintenance of the counter with the covers removed is inevitable, it shall be carried out only by a skilled person, who is aware of the hazard involved. Bear in mind that capacitors inside the counter may still retain their charge, even if the counter is disconnected from all voltage sources.

Opening of the cabinet or removing of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals that can be dangerous to life.

Line voltage setting

Before connecting the counter to the line, ensure that it is set to the local line voltage. On delivery, the counter is set to either 115V or 220V, as indicated on the line voltage selector on the rear panel. If the voltage setting is incorrect, set the line voltage selector in accordance with the local voltage, before connecting the counter to the line.

Fuses

The counter is protected by a thermal fuse, located in the line transformer, and a secondary fuse (1.6A fast-blow) on PCB U1. Remove the line plug before fitting a fuse. Ensure that only fuses of the specified type are used. If the counter is set for operation on 115V line voltage, but is connected to a 220V supply, the thermal fuse will blow immediately to protect the counter.

PHILIPS

PHILIPS

SERVICE

Scientific & Analytical Equipment
Test & Measuring Instruments
Industrial Automation
Advanced Automation Systems
Welding

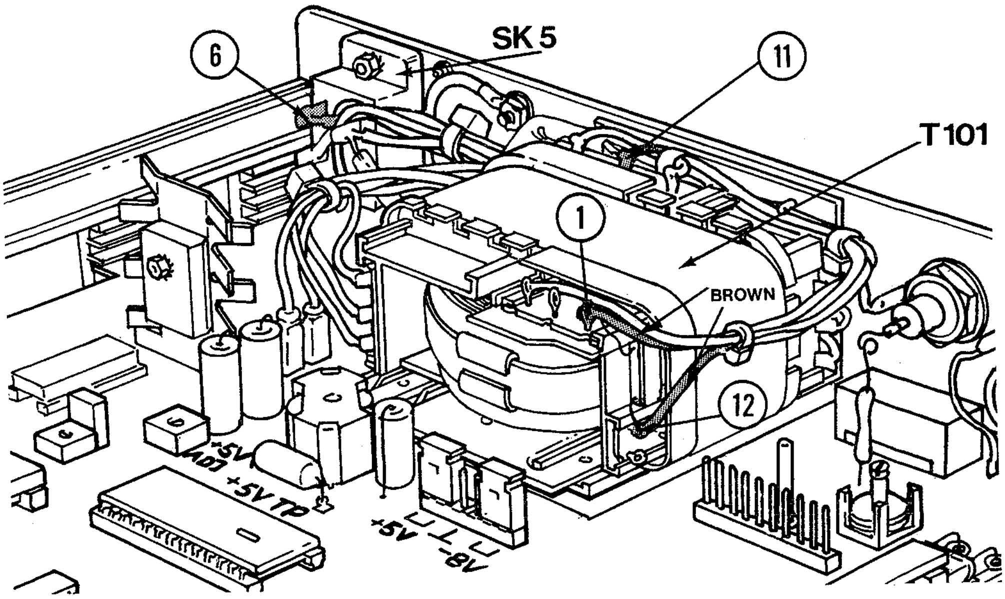
Scientific & Industrial Equipment Division

820515 PM 6673...76 SPC 44
9499 468 03811

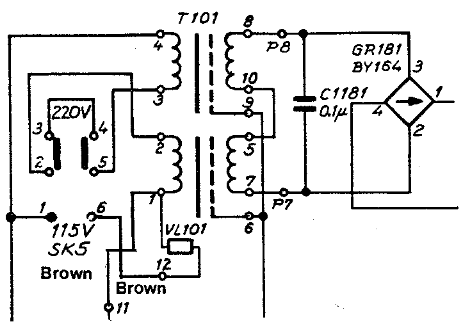
Important information regarding the safety of the instrument.

Among the first 200 delivered units of the new launched frequency counters PM 6673, PM 6674 and PM 6676, there are some units with a wrong connected thermal fuse. The reason is an unlucky choice of color on some cables.

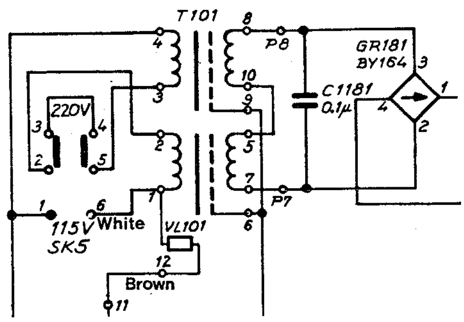
The two brown cables connected to T101:1 and T101:12, see below, must change places in the wrongly connected instruments. To prevent the same mistake in the future, e.g. when replacing the transformer, please replace the cable between SK5:6 and T101:1 with a white cable.



Wrong



Correct



CONTENTS

1. CIRCUIT DESCRIPTION

- 120MHz Input Amplifier
- Input D Amplifier
- OQ0040 Counter-on-a-chip
- The Microcomputer
- Measuring Time
- External Main Gate Network
- Automatic switch between conventional and reciprocal frequency measurement
- Microcomputer - OQ0040 Communication
- Microcomputer - Display - Function Selector Communication
- The Power Supply
- 550MHz Prescaler for PM 6674
- 600MHz Direct Gated Input for PM 6675
- 1500MHz Prescaler for PM 6676

2. PERFORMANCE CHECK

3. ADJUSTMENTS

- Required test equipment
- DC Voltage
- Schmitt Trigger Balance
- Measuring Time
- Frequency Adjustment of The Standard Oscillator
- PM 6674 Prescaler

4. SELF-TEST

5. TROUBLE-SHOOTING

6. REPLACING PARTS

7. CIRCUIT DIAGRAMS

8. SPARE PARTS LIST

9. OPTIONAL OSCILLATORS

1. CIRCUIT DESCRIPTION

A block diagram, a functional block diagram, circuit diagrams and component layouts can be found in Section 7.

120MHz Input Amplifier

The input amplifier for channel A is identical for all models PM 6673...76.

Due to high accuracy components, the input attenuator (R1001, R1003, C1002 and C1003) does not need to be adjusted. The input signal is AC-coupled by C1001. Input protection is provided by C1001, R1005 and the diodes GR101...104. Transistors TS101 and TS102 function as an impedance converter with very low output impedance. At high frequencies, TS101 is bypassed by C1008 to improve the HF characteristics of this stage. The sensitivity of the input amplifier can be adjusted with potentiometer R1013. The switch SK110 activates the 50kHz Low-Pass Filter R1012, L1001 and C1010. See section Theory of Measurements in the Operating Manual.

IC101 is a wide-band amplifier. The gain is set by R1020 and the HF range is improved by L1003 in series. A chip capacitor, C1015, prevents oscillation. The -5V regulated supply for IC101 is derived from the -8V line, via the voltage regulator IC102. Capacitor C1024 prevents DC variations from IC101 effecting the Schmitt Trigger TS103...105. The Schmitt Trigger is balanced by potentiometer R1025. Temperature stabilisation and level shifting are obtained by the diode GR106.

Switches SK111 and SK113 give an input DC offset (+ or -) to the amplifier IC101 and to the Schmitt Trigger, to provide for input signals with very high or very low duty factors. Refer to section Theory of Measurements in the Operating Manual for more information.

Resistors R1027 and R1028 convert the output from the Schmitt Trigger to positive ECL levels (high 4.2V and low 3.2V).

Input D Amplifier

This Schmitt trigger/amplifier is an AC-coupled input for external standard or ratio measurement. The output is an ECL signal, as shown in Fig. 1.1.

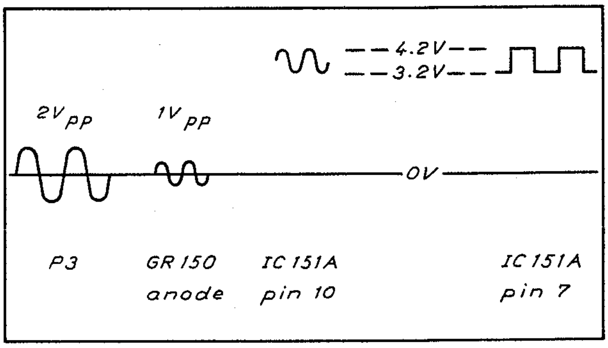


Fig. 1.1 A 100kHz sine-wave with $2V_{pp}$ amplitude, connected to Input D.

Internal or external standard can be selected with switch SK114 on the rear panel. Even if an external standard is used, the internal standard is still used as a clock signal to the microcomputer. When an optional oscillator is installed in the counter, the crystal KT151 must be removed. IC151B will then be used as an amplifier.

IC151C is a buffer amplifier between the oscillator and the logic circuits. Output pins 14 and 15 of IC151C give two complementary ECL signals, which are converted to TTL signals in the differential amplifier TS151 and TS152. The TTL signal is available at INT STD OUT on the rear panel. This output can be used as an external input signal to an other counter.

The 10MHz standard signal is divided by two in IC152A to provide a 5MHz clock signal for the microcomputer. The 5MHz signal is also divided by two in IC152B to provide a 2.5MHz clock signal for the optional Bus Interface PM 9696 via BU101:9.

0Q0040 Counter-on-a-chip

The 0Q0040 (IC161) is an in-house developed LSI counter-on-a-chip. It contains two 9-decade counting registers. One is used for counting 100ns clock pulses from the x-tal oscillator and the other is used for counting pulses from the signal to be measured, see Fig. 1.2. An input synchronizing and timing control block precedes these two counting registers. Its purpose is to:

- connect A (pin 1), B (pin 27), CARRY (pin 28) and CLK (pin 2) to the correct decade counting register.
- synchronize the start and stop of the measurement.
- act as a main gate for functions using the internal main gate in 0Q0040.
- control the external main gate IC140 with the TRIGG signal (pin 4).
- inform the microcomputer (IC162) with the signal READY (pin 24) when a measurement has started and stopped.
- receive a request to terminate a measurement, SCAN CLK/STOP (pin 5).

The microcomputer resets the counting registers in 0Q0040 and makes it ready for a new measurement by sending information to ST/ST/DATA (pin 25), see section Microcomputer - 0Q0040 Communication. When 0Q0040 receives an input signal,a new measurement starts as soon as the synchronization condition is met. With EXT CONTROL it is possible to delay the start until a positive pulse is received at EXT CONTROL.

When the measurement is completed, the microcomputer reads the registers in 0Q0040. The registers are read one by one in a scanned mode. The microcomputer supplies clock pulses to SCAN CLK/STOP for controlling the scanning. DECADE 9 (pin 8) indicates which part of the reading cycle the microcomputer is reading. A more detailed description can be found in section Microcomputer - 0Q0040 Communication. If an external decade counting register is used, the microcomputer reads it via 0Q0040 "Data from external ECL decade" pin 10, 11, 18 and 19 in BCD format.

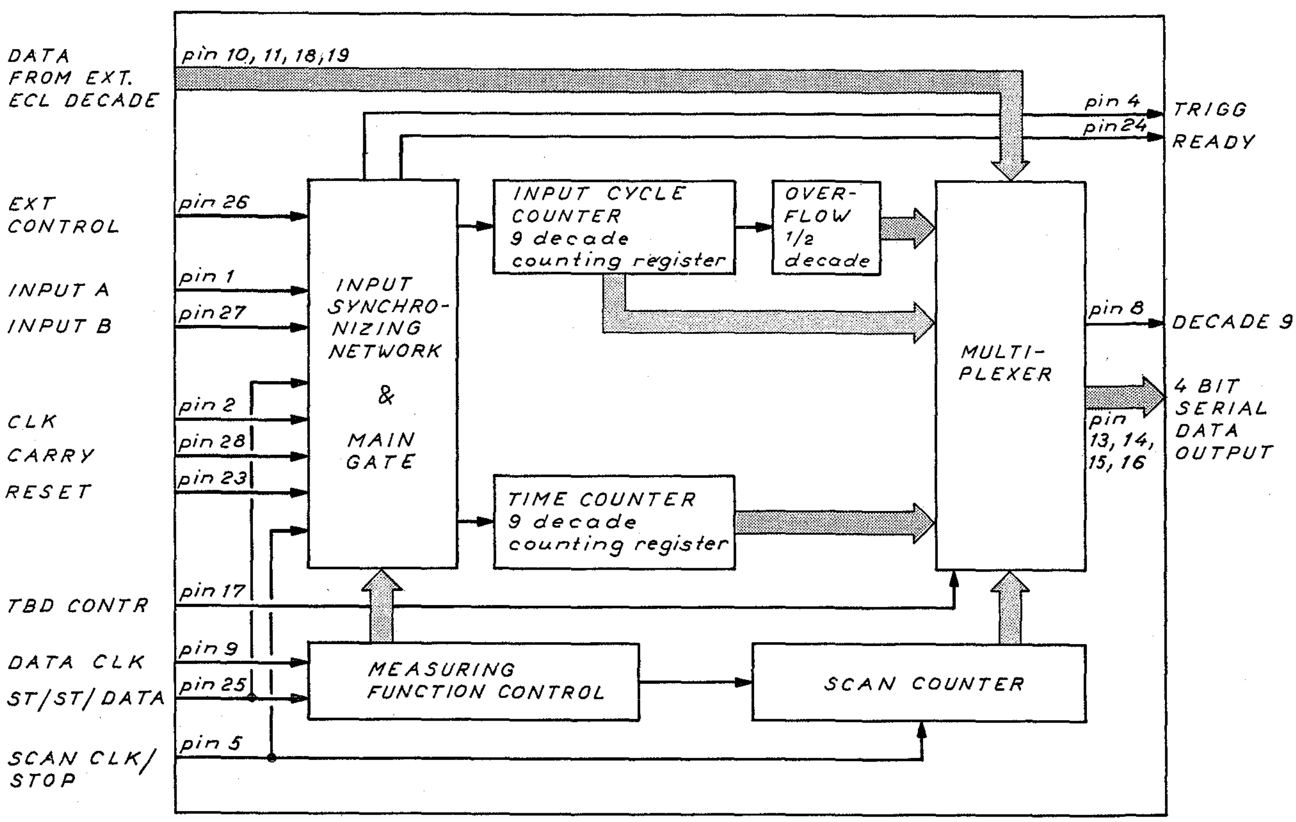


Fig. 1.2 Simplified block diagram of 0Q0040.

The Microcomputer

The microcomputer (IC162) used in PM 6673...76 is an 8049 single-chip microcomputer with an 8-bit bi-directional data bus and 16 static input/output ports. The internal memory consists of 128 byte RAM (read/write memory) and 2K byte ROM (Read-Only-Memory) for the program.

The microcomputer performs the following functions:

- Reads the setting of the function selector pushbuttons and the measuring time control on the front panel.

- Sends control information to 0Q0040 and other logic circuits.

- Reads the decade counting registers in 0Q0040 and the external decade (IC160) after the measurement.

- Calculates and sends the result to the display with correct resolution.

If the RESET pushbutton is pressed, the microcomputer is forced to start from RESTART in the program and all logic circuits are initialized, see Fig. 1.4.

The 8049 microcomputer has a timer function. Every 0.5ms, the timer function interrupts the microcomputer. In the interrupt routine, a new digit lights, a control setting is read and during a measurement the measuring time is counted down 0.5ms, see Fig. 1.3.

In Count A mode, the register content is read each 25ms and the display is updated each 25ms. In reciprocal frequency mode, 20 input cycles are needed to start and to stop a measurement because the input signal is divided by 10. The total measuring time is shown in Table 1.1 and the program flow-chart is shown in Fig. 1.4. The program memory for the options PM 9694...96 is located on the PCB of the particular option. The microcomputer reads the program instructions via BU101. The 12-bit address is sent via the data bus (8 bits) and via ports 20...23 (4 bits). This address is used for pointing to a program instruction in the program memory. With the signal PSEN, the microcomputer commands the program memory to send out the instruction on the data bus. After that, the microcomputer fetches the instruction and executes it.

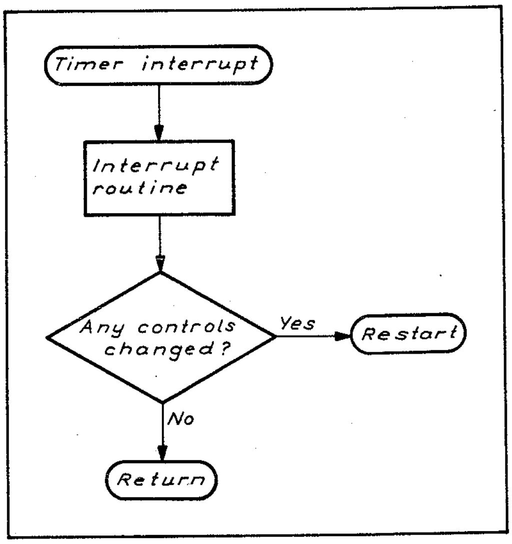


Fig. 1.3 Timer interrupt each 0.5ms.

Function	Total time
Period A	MT + 45 ms
Frequency	
Conventional	MT + 50 ms
Reciprocal	MT + 45 ms
Automatic	MT + 60 ms
Ratio to D	MT + 50 ms

MT= set measuring time + time for synchronizing start and stop of a measurement.

Table 1.1 Measurement initialize, perform and terminate times.

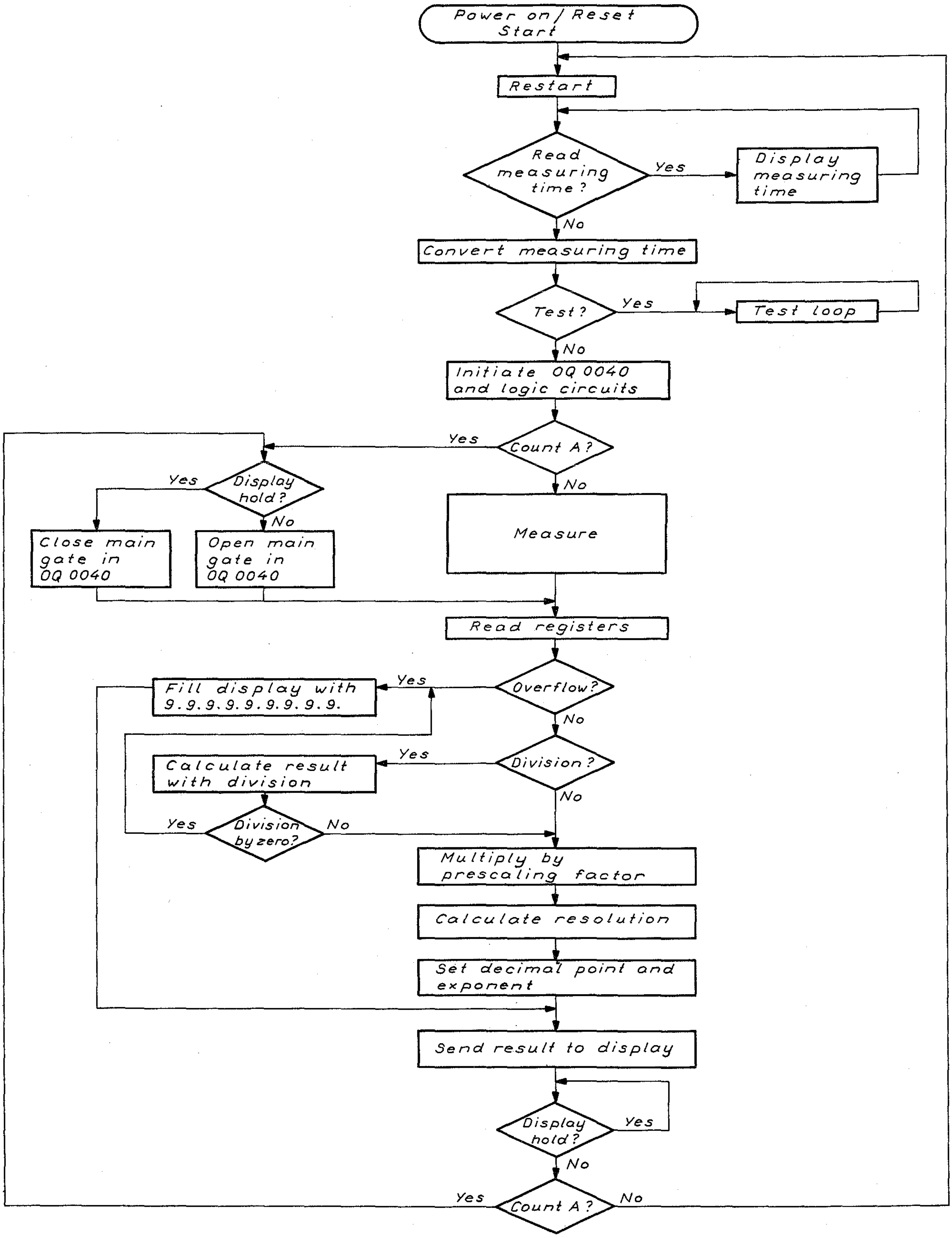
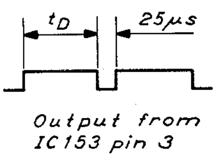


Fig. 1.4   The program flow-chart.

Measuring Time

IC153 is used as an astable multivibrator, with the MEASURING TIME potentiometer controlling the frequency. The output from IC153 pin 3, see Fig. 1.5, is connected to the microcomputer input T1. The pulse duration is measured and converted to a measuring time, which can be varied in 33 steps per decade between 10ms...96s.



t_D	Measuring time
80µs	10ms
1.8ms	96s

Fig. 1.5 The pulse duration is converted to a measuring time in the microcomputer.

The space between pulses is set by R1167 and C1156. The pulse duration is set by R1166, R1167, C1156 and the MEASURING TIME potentiometer R1 on the front panel. Potentiometer R1164 is used for adjusting the max pulse duration to 1.8ms.

If the jumper DV1 (TEST) is removed, the counter is set to the self-test mode.

External Main Gate Network

This network consists of the ECL Main Gate FF (IC140A) and ECL Main Gates & Input Select (IC141 and IC142).

The main gate is used to accurately open and close the signal path to the counting registers, controlled by the set measuring time. In the PM 6673...76 series of counters, there are two different main gates:

- One internal in OQ0040.
- One external for a higher frequency range, IC141.

Table 1.2 shows which main gate is used for different measuring modes.

When the internal main gate in OQ0040 is used, IC141A and B are used for selecting Input A or Input B. IC141C is used for the 10MHz reference signal in the CHECK mode.

When the external main gate IC141 is selected, one of the three gates functions as main gate:

IC141A Main gate for Input A.
IC141B Main gate for Input B.
IC141C Main gate for the 10MHz reference signal in CHECK mode.

To select the external main gate, the microcomputer sets the signal EXT. DECADE low. If the microcomputer sets the signal CH A high (via TS132), IC141A is selected as main gate, i.e. Input A is used. Otherwise, Input B is used.

FUNCTION	MAIN GATE		INPUT (OQ 0040)	SYNC	NOTE
	INT.	EXT.			
PERIOD A	X		Input A	X	
			CLK		
COUNT A	X		Input A		The Main Gate is controlled by DISPL HOLD via the µC
FREQ input synchr.	X		Carry	X	
			CLK		
FREQ clock synchr.		X	Carry		External counting decade
			CLK	X	
RATIO to D		X	Carry		External counting decade
			Signal via Input D:Input B	X	

Table 1.2 Main gate and synchronization for different measuring modes.

The measurement starts when the microcomputer sets RESET low and IC140:6 receives a trigger pulse from the TRIGG output of IC161. The pulse sets the output IC140:2 high. This signal is called the Main Gate Signal.

To terminate a measurement, a new pulse is sent from the TRIGG output. The Main Gate Signal goes low and the main gate is closed. The pulse also sets IC140:15 high and by "wired-OR function" closes the clock input IC140:6 (see Fig. 1.6) to prevent further triggering on IC140:2.

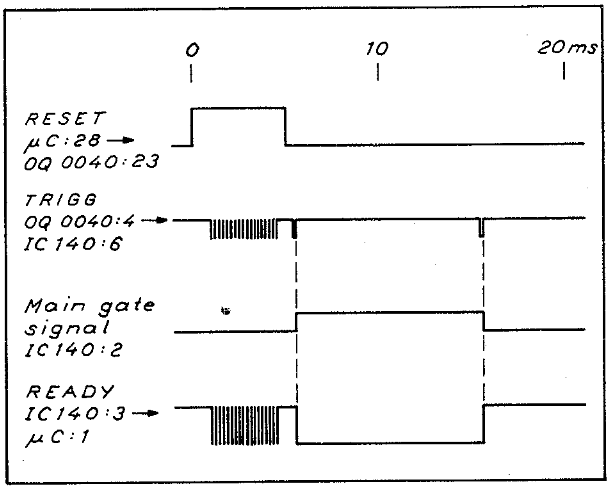


Fig. 1.6 10ms measurement with an external main gate.

The function PERIOD A uses Input A, thus CH A (IC162:30) is high. The external main gate is not used, i.e. EXT DECADE is high, see Fig. 1.7.

NOTE: Fig. 1.7-1.11 can be found in section 7, Circuit Diagrams.

The function COUNT A uses Input A and the internal main gate in 0Q0040. The measurement is selected with pushbutton COUNT A, initiated by releasing DISPL HOLD and terminated by pushing DISPL HOLD. The signal ST/ST/DATA is controlled by the pushbutton DISPL HOLD. This signal controls the internal main gate in 0Q0040. ST/ST/DATA is low for an open main gate, i.e. pulses are counted (refer to Fig. 1.8). Every 25ms the decade counting registers are read and displayed. However, the measurement is not interrupted.

When the CHECK pushbutton is depressed, IC141C works as main gate for selected measuring functions where an external main gate is used.

If Input A is selected, CH A is high and the prescaler is turned off via BU107:1. If Input B is selected, CH A is low. A jumper between BU107:5 and BU107:6 on the prescaler board, routes the main gate signal from the IC142:3 output to IC141B:13. Refer to Fig. 1.9 for signal path.

An external main gate is used for ratio and clock synchronized frequency measurements. The difference between a ratio and a frequency measurement, is that ratio uses Input D as reference and frequency uses the 10MHz standard, see Fig. 1.10.

For the reciprocal mode, Input A and the internal main gate in 0Q0040 are used. The frequency of the input signal is divided by 10 in IC160, ECL 120MHz Decade. This decade counting register is not read. It is only used as a scaler in this mode. IC142D gives the signal a duty factor of approx 0.50. The signal path is shown in Fig. 1.11.

<u>Automatic switch between conventional and reciprocal frequency measurement</u>

Before the actual frequency measurement is made, the counter makes a short measurement over 10us to determine if a conventional or a reciprocal frequency measurement is to be made. If the input frequency is higher than approx 10MHz a conventional, clock synchronized, measurement is made. Refer to Fig. 1.12 and to the section Theory of Measurements in the Operating Manual.

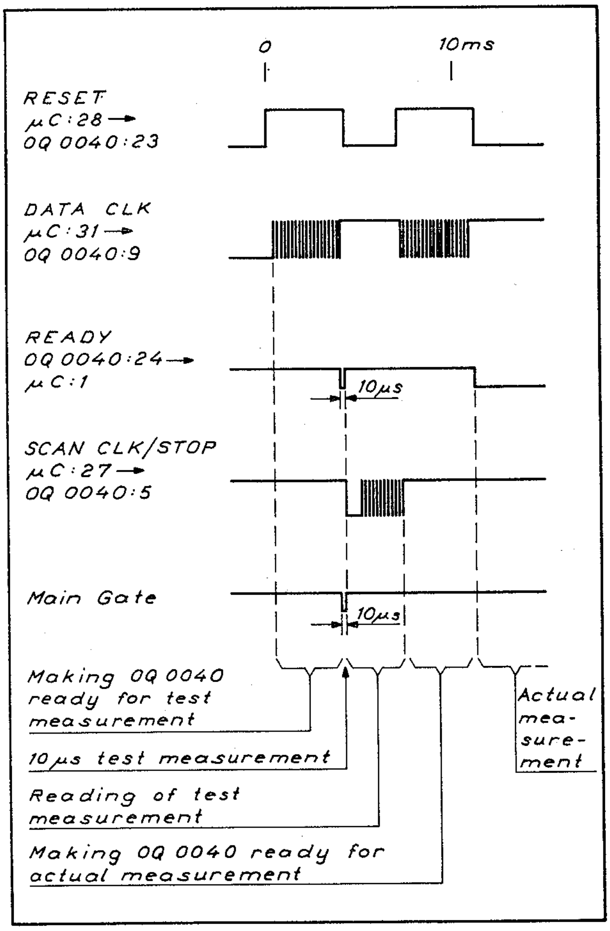


Fig. 1.12 Test for selecting conventional or reciprocal frequency measurement.

<u>Microcomputer - 0Q0040 Communication</u>

Before the measurement, the microcomputer sends control information to 0Q0040. This information is sent when pin 28 of the microcomputer is high, i.e. 0Q0040 is reset. The information bits are sent in serial format to ST/ST/DATA, one bit for each positive-going slope of DATA CLK, see Fig. 1.13. The information consists of 39 bits.

When pin 28 of the microcomputer goes low again, the measurement starts as soon as the synchronization conditions are met. Then 0Q0040 pin 24 READY goes low, the microcomputer acknowledges by setting ST/ST/DATA high and starts to count down the selected measuring time.

During the actual measurement the microcomputer and 0Q0040 do not communicate. When the selected measuring time has elapsed, the microcomputer sets SCAN CLK/STOP low. 0Q0040 then stops the measurement when the synchronization conditions are met and sets READY high.

The content in the 18 decade counting registers in 0Q0040, plus the external ECL 120MHz decade (IC160), are sent in BCD format to the microcomputer from $A_{out}...D_{out}$. The microcomputer reads one decade at a time and steps to the next decade by sending clock pulses to SCAN CLK/STOP. To read a digit, TBD CONTR is set high.

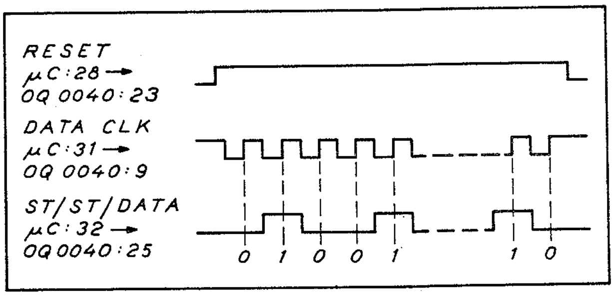


Fig. 1.13 The microcomputer sends information needed to make 0Q0040 ready for a measurement.

To find out which decade is read, the microcomputer sends clock pulses to SCAN CLK/STOP until DECADE 9 (pin 8) goes high. This indicates that the position is decade 9. The microcomputer starts reading, see Fig. 1.14. The external ECL decade is read via 0Q0040 $A_{in}...D_{in}$.

When all 19 decade counting registers have been read, the microcomputer calculates the result and sends it to the display. It resets 0Q0040 and a new measurement can now start.

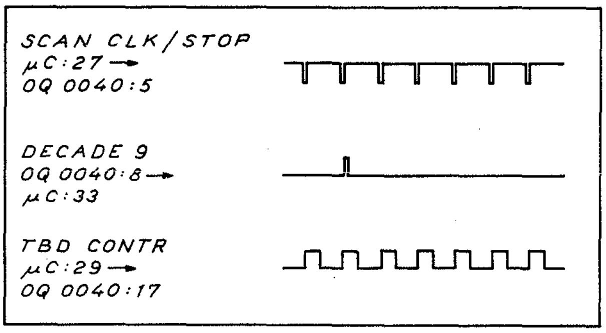


Fig. 1.14 A new digit is read after each pulse to SCAN CLK/STOP when TBD CONTR is high.

Example:

Function selector setting:

- Depress PERIOD A, ⊓⊔ and CHECK
- Set measuring time to 10ms
- Set the Input E switch to EXT RESET

A suitable trigger signal for an oscilloscope is available on 0Q0040 pin 23 (RESET).

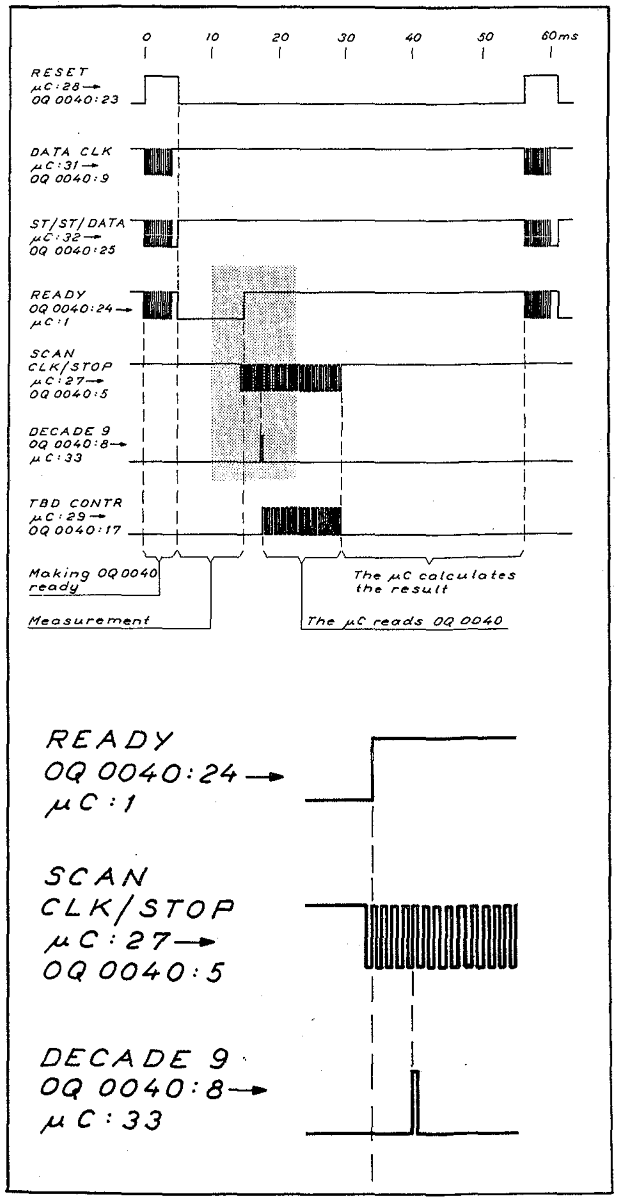


Fig. 1.15 Timing diagrams for microcomputer and 0Q0040 communication.

Microcomputer - Display - Function Selector Communication

The Display, Decimal Points, Unit Indicator and Function Selector are scanned by the microcomputer. During each scanning cycle the microcomputer sends out the measured result and reads the setting of the Function Selector. Each digit is sequentially turned on for 0.5ms. The measurement can be sent both to the display and an installed option, e.g. Bus Interface, via connector BU101. The microcomputer pin 38 (P27) controls the information flow.

P27 low: the display and function selector is addressed
P27 high: the installed option is addressed

The bidirectional data bus DB0...DB7 on the microcomputer is used for sending information to the display and receiving information from the function selector. The microcomputer pin 8 (RD) and pin 10 (WR) control this information flow.

WR pos flank: information is sent to the display
RD pos flank: information is received from the function selector

Four bits, DB4...DB7, are used for sending (in BCD format) the digits to be displayed. Each digit in the display shows its specific value for a period of 0.5ms. The digit's value is latched and decoded to a seven-segment format in the Segment Decoder/Driver (IC201). The remaining four bits, DB0...DB3, are used for addressing the digit to be displayed. Thisaddress is sent in BCD format. The address is latched in the Address Latch (IC164) and decoded in the Digit Decoder (IC165). Only one of the outputs in the Digit Decoder is high at a time. This high signal, opens the corresponding Digit Driver for 0.5ms. At the same time, the digit's value is sent from the Segment Decoder/Driver. During the following 0.5ms, the next digit is turned on, and so on.

The current flows from the +5V supply through the digit driver transistor, the lighted segments and then to earth via the Segment Decoder Driver. All digits have a decimal point. Digit drivers 1...6 also have a Unit Indicator LED connected. Signal lines P24 (pin 35) and P25 (pin 36) of the microcomputer control them.

P24 low: a decimal point is lit
P25 low: a unit indicator LED is lit

The microcomputer blanks leading zeros by setting P26 (pin 37) low. This blanking signal is also used for the Fail Safe Circuit. If the microcomputer stops, one digit will remain lit and could be degraded after a couple of minutes. If P26 (pin 37) stays high, C1163 will be charged to +5V. This results in a reset signal to the Address Latch. All outputs goes low. The Digit Decoder sets output pin 3 high. Pin 3 is not connected to any digit driver so all digits will be turned off.

The output from the Digit Decoder is also used for reading the setting of the function selector switches DISPL HOLD, COUNT, RATIO to D, PERIOD, FREQ, FREQ A AVERAGE, Input B and PUSH TO READ measuring time. Each output from the digit decoder is connected to one switch. When a digit is lit, the microcomputer reads the setting of the corresponding switch. This is achieved by the RD output going low, which opens the tristate buffer IC163. The switch setting information is now available on the bidirectional data bus, DB0... DB3, to the microcomputer. The prescaler coding diodes (part of Unit 3) are sensed in the same way.

The logic states are as follows:

Closed switch: logic high level
Open switch: logic low level

The function of the diode GR140 is to inform the microcomputer that this is a PM 6673...76 counter. This diode is not installed in PM 6670...72.
The same microcomputer (8049) is used in all counters of the PM 6670 series.

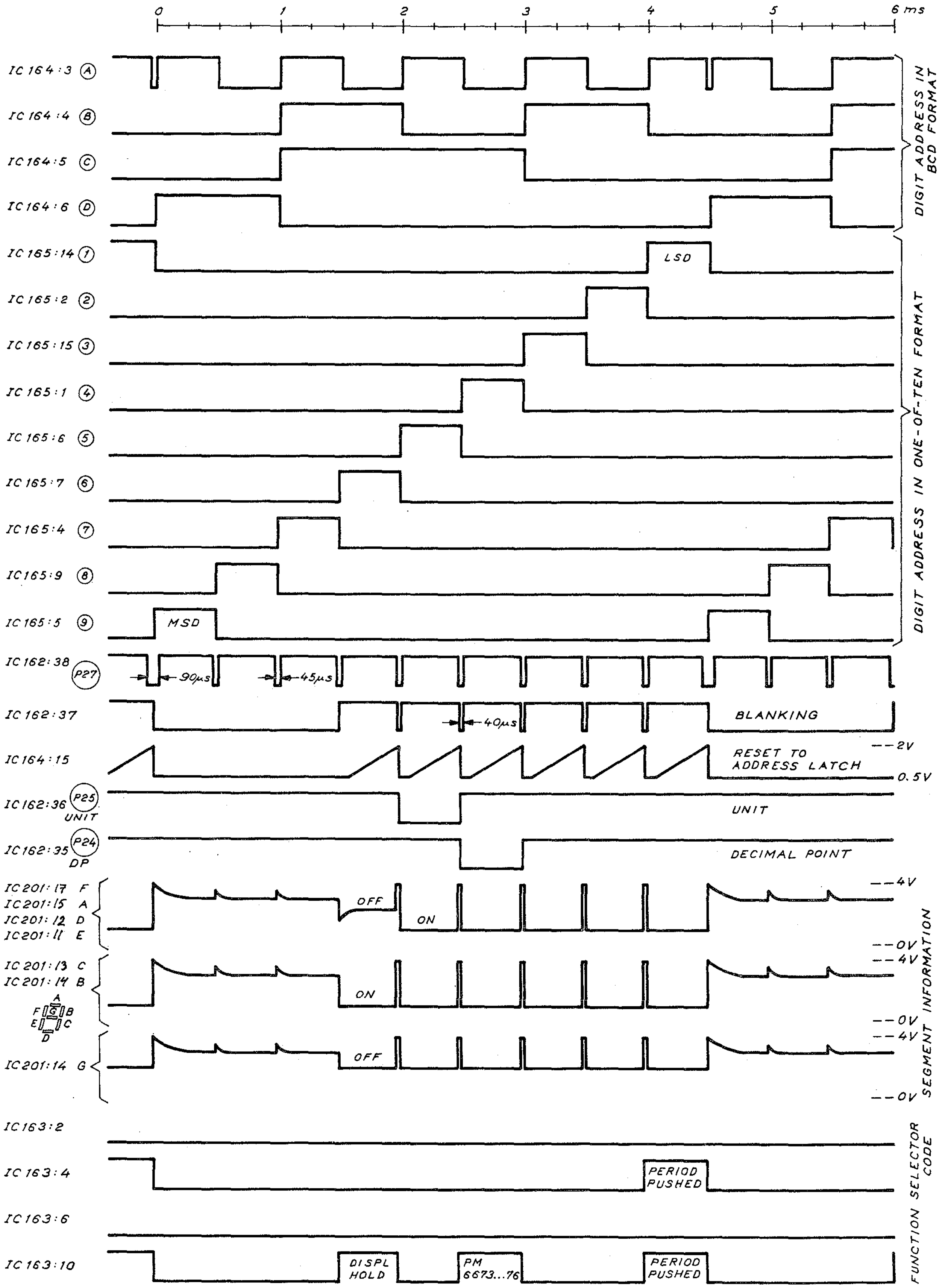


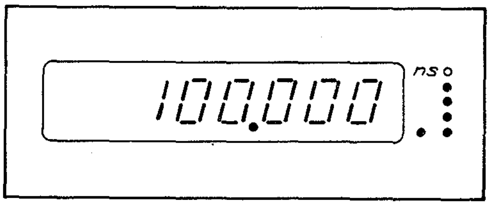
Fig. 1.16A Timing diagrams for Microcomputer - Display - Function Selector communication. Applicable to the example on the following page.

Example:

Function selector setting:

- Depress PERIOD A, ⊓⊔ , CHECK and DISPL HOLD
- Set measuring time to 10ms
- Set Input E switch to EXT RESET

The display will show:



A suitable trigger signal for an oscilloscope is available on IC165 pin 5. Timing diagrams are shown in Fig. 1.16.

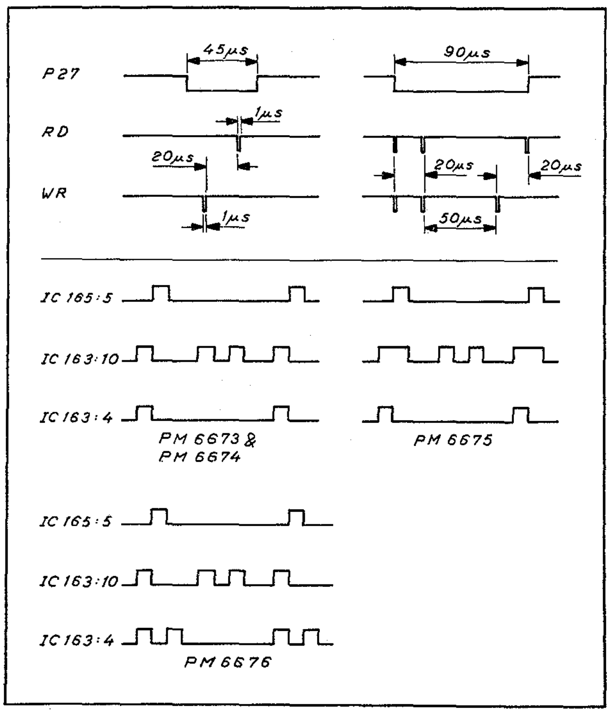


Fig. 1.16B A close-up of some timing diagrams in conjunction to Fig. 1.16A.

<u>The Power Supply</u>

The PM 6673...76 series of counters can be connected to

- $115V_{AC}$ or $230V_{AC}$ ±10%, 45...440Hz
- $11.8...28V_{DC}$
- The optional battery pack PM 9693 ($12V_{DC}$)

The output from the power supply is

- +5V regulated
- -8V unregulated.

The counter is protected by a thermal fuse VL101 located in the line transformer and a secondary fuse VL102 (1.6A fast-blow) on PCB U1. At VL102 the voltage is approx $25V_{DC}$ in a PM 6673/01 connected to $220V_{AC}$.

When the optional internal battery pack PM 9693 is installed, the voltage on pin BU104:7 is used for charging the battery. BU104:7 is connected to BU104:6 via a jumper when PM 9693 is not installed.

The POWER ON/OFF switch SK101 on the front panel is a secondary switch, which has no effect on the voltage supply to the optional oven stabilized oscillator.

In position POWER ON, the voltage is supplied to IC180 via the transistor TS184 and diode GR186, which form a voltage limiter. The voltage is limited to approx $15V_{DC}$.

IC180 is specially designed for applications in switched-mode power supplies. The output control signal (pin 14) is connected to the switch transistor TS182. This pulse train has constant amplitude and frequency, but a pulse duration that is dependent on the load. The frequency (40kHz approx) is set by resistor R1197 and capacitor C1192.

The control loop senses the +5V output via R1187...1189, as shown in Fig. 1.17. The +5V output is adjustable with potentiometer R1188.

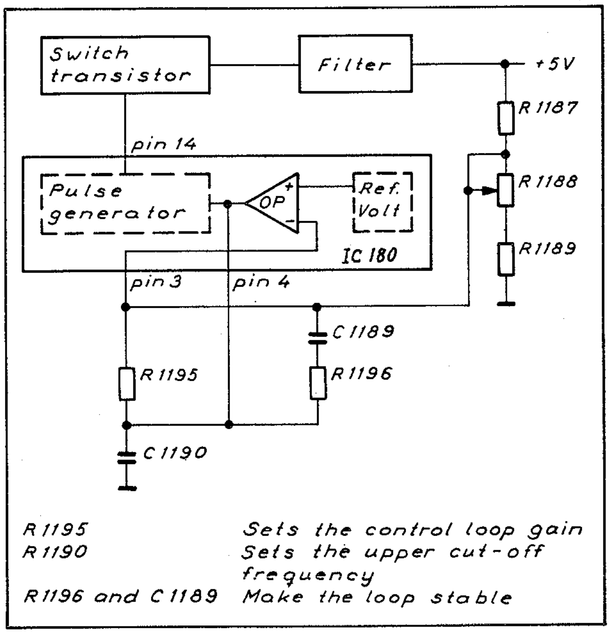


Fig. 1.17 IC180 and the control loop.

The amplifier output (IC180:4) is 4V for 12V input and 2V for 30V input. The output is 8.5V when the power supply is not regulating. This 8.5V is used to reset the microcomputer at POWER ON and at line (mains) failures of short duration.

The output from the OP amplifier controls the pulse duration to the switch transistor TS182. When TS182 is conducting, magnetic energy is stored in the transformer T102. When TS182 stops conducting, the magnetic energy is discharged via the diode GR183. Some of the magnetic energy is discharged via the secondary winding of T102 to obtain the unregulated -8V.

When the current increases, the voltage across resistor R1182 increases, and at a current through R1182 of approx 2A, transistor TS181 starts conducting. When the voltage at IC180:11 exceeds 0.5V, the pulse duration decreases to avoid current surge. The diode GR185 gives over voltage protection.

550MHz Prescaler for PM 6674

The 550 MHz prescaler for PM 6674 is AC-coupled and divides the frequency of the Input B signal by 6.

Capacitor C301 blocks any DC component on the input signal, while the network R301...R303, GR301 and GR302 form a PIN diode attenuator and provide the required input impedance. The PIN diode GR302 and the resistor R302 form a variable attenuator, controlled by the amplitude of the signal to be measured. The current through R301...R303 and the Schottky diode GR301 makes the PIN diode reversed biased with a bias voltage of approx 0.65V.

The PIN diode attenuator is not activated for input signals with low amplitude. If the input amplitude increases to a level that makes GR301 rectify, the DC level of the input signal will decrease, as the positive voltage then is limited. The PIN diode GR302 will start conducting when the DC level has decreased from +0.5V to -0.65V. A PIN diode has a current controlled variable impedance. An increased input amplitude, increases the current through the PIN diode. Thus giving it lower impedance, i.e. higher attenuation in the attenuator R302 and GR302. The result is an almost constant amplitude at IC301:3 when the PIN diode attenuator is activated.

IC301 is a wide-band amplifier. The gain and frequency of the output signal from IC301 are controlled by TS301, R310, C307, C306, R311 and TS302. The network GR305, GR306 and C308 forms a limiter at the input of the divider IC302. Transistors TS301 and TS302 also form a buffer amplifier between IC301 and IC302.

In IC302, the frequency is divided by 6. To prevent errors due to insufficient amplitude, the amplitude of the input signal to IC302 is monitored. The detector diode is GR304 and the bias current through this diode is provided by R318, R323 and R315.

In the Schmitt trigger (IC303 and R324...326) this detector voltage is compared with a reference voltage set by potentiometer R316. If the detector voltage is lower than the reference voltage, IC 302 pin 8 and pin 1 are set to low logic level. This means that the signal passes through IC302. When the input amplitude decreases, the detector voltage increases. If the detector voltage exceeds the reference voltage, IC302 is disabled. The output signal has ECL levels and is connected to the main gate network on Unit 1 via BU307:10.

For test purpose, IC302 could be enabled independently of input amplitude, by connecting +5V to BU307:2 (TEST). When channel B is not used, BU307:1 is set to +5V and IC302 is disabled.

<u>600MHz Direct Gated Input for PM 6675</u>

The difference between Input B of PM 6674 and PM 6675 is that PM 6675 has a readable decade divider (IC301) which gives PM 6675 one more digit of resolution for the same set measuring time.

This AC-coupled input is protected by a PIN-attenuator (GR303, GR304, R302) and two Schottky diodes (GR301, GR302). When the amplitude of the input signal increases, the current through the Schottky diodes increases. This results in an increased current through the PIN diodes and as a result, their impedance decreases. The voltage attenuation between R302 and the PIN diodes changes so that the amplitude on the base of TS301 is constant.

Transistors TS301...305 form a 5-stage DC amplifier with frequency compensation. The DC gain is less than 1 and the AC gain is 40...45dB. To prevent DC shift due to temperature variation, the transistor pairs TS302/303 and TS304/305 are of different types, PNP resp. NPN.

The frequency of the input signal is divided by 10 in the readable decade divider IC301. When IC301 needs to be read, a pulse is sent to the tri-state buffer IC302. Then a BCD-coded digit is sent to the microcomputer (IC162) via the buffer. The read pulse is generated by the signals DEC 9 (high), TBD CONTR (high) and B (low) via IC303.

The main gate signal from the counter, is sent via BU3:5 and the level converter network TS307, TS308, GR311, R341...R343 and R349 to IC301 pin 16. A voltage of -2V at IC301:16 implies open main gate, -0.9V implies closed main gate. When the main gate is closed, IC301 is read.

The CARRY output from IC301:9 is converted to ECL levels by TS309, GR319 and R345... R347. This signal is sent via BU3:10 to the next decade (IC160) on Unit 1.

If the amplitude of the input signal is too low, IC301 is reset to prevent erroneous counting. The detector network consists of L303, C320, L302, C336, R332, GR308, C322, R363 and R364. Higher amplitude results in a higher DC voltage on pin 2 of the Schmitt trigger IC304. The reference voltage is set by potentiometer RV301. When the detector voltage is higher than the reference, the Schmitt trigger output is low and the reset signal to IC301:3 is disabled, i.e. counting is possible. IC301 can also be reset by the microcomputer (IC162:28) via BU3:3. For testing purpose, it is possible to make IC301 count even if the amplitude of the input signal is too low. This is accomplished by connecting +5V to BU3:2 (TEST).

The diode GR315 generates a code, which indicates to the microcomputer that the counter is a PM 6675.

In CHECK mode, the two least significant digits are dependent on set measuring time.

1500MHz Prescaler for PM 6676

This AC-coupled input is protected by a PIN-attenuator (GR303, GR304, R302) and two Schottky diodes (GR301, GR302). When the amplitude of the input signal increases, the current through the Schottky diodes increases. This results in an increased current through the PIN diodes with a corresponding decrease in their impedance. The voltage attenuation between R302 and the PIN diodes changes so that the amplitude on the base of TS301 is constant.

Transistors TS301...306 form a 6-stage DC amplifier with frequency compensation. The high-frequency response can be adjusted with capacitors C308 and C318. The DC gain is less than 1 and the AC gain is 30...35dB. IC301 and IC302 each divide the frequency of the input signal by 4, i.e. the frequency is divided by 16 in total. The output ECL signal from IC302:10 is sent to the main gate in the counter via BU307:10.

The amplitude of the input signal is sensed via the network C323, R329, GR309, C326 and R330. The voltage on IC303:2 decreases when the amplitude of the input signal increases. When the detector voltage is lower than the reference voltage (set by potentiometer R333) the output of the Schmitt trigger IC303:6 is high, i.e. the signal to be counted is able to pass through IC302.

When the amplitude of the input signal is too low, the Schmitt trigger output is low, which results in a current through the diode GR314, i.e. the signal is stopped. This prevents erroneous counting. For testing purpose, it is possible to open IC302 even for small input amplitudes. This is accomplished by connecting +5V to BU307:2 (TEST).

The connection TEST POINT is used when adjusting the frequency response. The diode GR315 generates a code, which indicates to the microcomputer that the counter is a PM 6676.

2. PERFORMANCE CHECK

Required test equipment

- Voltmeter, e.g. Philips PM 2517
- Frequency counter, e.g. Philips PM 6673/02
- 50MHz oscilloscope, e.g. Philips PM 3215
- Sampling oscilloscope, e.g. Philips PM 3400
- Pulse generator, e.g. Philips PM 5771
- Function generator, e.g. Philips PM 5131
- HF signal generator, e.g. Wavetek 2002A
- Probe, 10 Mohm, 120MHz
- T-piece, BNC-type
- Termination, 50 ohm, BNC-type

Initial set-up

All pushbuttons should be in a released position. The slide switches on the rear panel should be set to INT STD and EXT RESET. Set the line voltage slide switch on the rear panel to the local line voltage. Connect the counter to the line and press POWER ON.

Check of the oscillator

The /01 version of PM 6673...76 can be checked by connecting a counter, e.g. a PM 6673 equipped with at least a calibrated TCXO, to INT STD OUT (via a 10Mohm probe) on the rear panel. The frequency should be 10MHz ± 10Hz.

For /02.../05 versions, please refer to section Optional Oscillators.

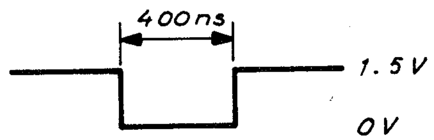
Check of Input D sensitivity

Press RATIO to D and CHECK. Connect a 1kHz sinewave with $1.2V_{pp}$ amplitude to Input D. Set the slide switch for Input D to EXT STD IN. Set the measuring time to 1.0s and check that the display read-out is 1.000. Set the slide switch for Input D to INT STD.

Check of Input E

Press PERIOD A and CHECK. Set the measuring time to 1.0s. Set the slide switch for Input E to EXT RESET. A DC voltage of +0.5V connected to Input E should not reset the counter, but +1.5V should. A positive pulse with +1.5V amplitude and 180us duration should reset the counter.

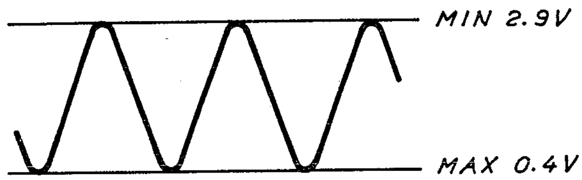
Set the slide switch to position ARMING. The arming function is described in the operating manual. A DC voltage of +0.5V connected to Input E should not arm the counter, but +1.5V should. A pulse, as illustrated below, should release the counter from the arming mode.



Set the slide switch to position EXT RESET.

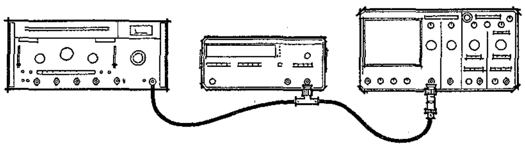
Check of INT STD OUT

Connect an oscilloscope via a 10Mohm probe to the INT STD OUT connector on the rear panel. Voltage levels are illustrated below.



Check of Input A

Press FREQ and ⊓⊔ . Set the measuring time to 10ms and the sensitivity fully clock-wise and depressed. Connect a sine-wave with $20mV_{pp}$ amplitude to Input A. The amplitude should be checked with an oscilloscope, see below.



Check that the counter display is correct when the frequency is adjusted between 10Hz and 120MHz. Decrease the amplitude to $5mV_{pp}$. The display should be zero (no counting) for frequencies between 10Hz and 120MHz.

Check of the attenuator

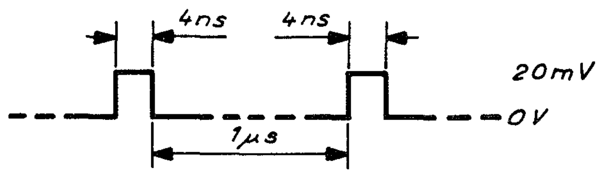
Connect a 10MHz sine-wave to Input A. Set the sensitivity control fully counter clock-wise and depressed. The display should be correct for an input amplitude of $350mV_{pp}$. Set the sensitivity control fully clock-wise and pulled. The display should be correct for an amplitude of $600mV_{pp}$. Push the sensitivity knob, i.e. max sensitivity, and increase the amplitude as much as possible, but max to $12V_{RMS}$. The display should still show a correct value (10MHz).

Check of the low-pass filter

Press the < 50kHz FILTER pushbutton. Connect a 500kHz sine wave to Input A. Check that the display is correct for an amplitude 20dBm (10x) higher than the sensitivity without filter.

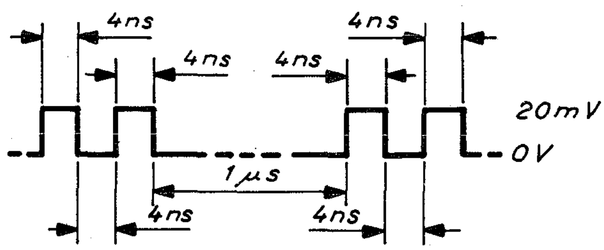
Check of the pulse sensitivity

Press the ⊓_⊓ pushbutton. Connect the signal below to Input A.



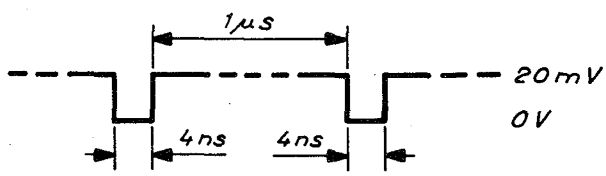
The counter should count correctly.

Connect the signal below to Input A.



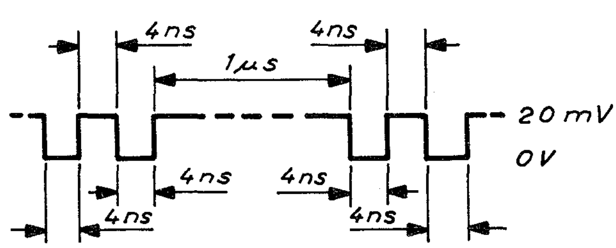
The counter should count correctly, i.e. twice the value of above.

Press the ⊔‾⊔ pushbutton. Connect the signal below to Input A.



The counter should count correctly.

Connect the signal below to Input A.



The counter should count correctly, i.e. twice the value of above.

Check of the display

Press the FREQ pushbutton. With no signal connected, press RESET. The display should be 000000000. Connect a 10MHz sine-wave with $1V_{pp}$ amplitude to Input A. Set slide switch D on the rear panel to position EXT STD IN. Press RESET. The display should be 9.9.9.9.9.9.9.9.9. Set slide switch D to position INT STD.

Check of the PERIOD function

Press the ⊓⊔ pushbutton and set the measuring time to 1s. Press PERIOD A and connect a 14MHz sine-wave with $30mV_{pp}$ amplitude to Input A. Approx 70ns should be displayed.

Check of the FREQUENCY function

Press the FREQ pushbutton and connect a 5Hz sine-wave with $50mV_{pp}$ amplitude to Input A. Set slide switch E on the rear panel in position ARMING. The display read-out should be:
5.XXXXXX Hz.

Press PERIOD A and FREQ simultaneously. The display read-out should be 0.005kHz.

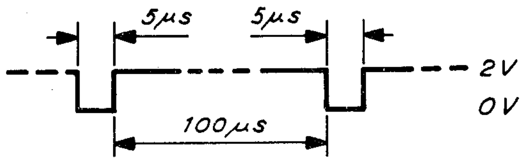
Check of the RATIO function

Press the RATIO to D pushbutton and connect a 120MHz sine-wave with $50mV_{pp}$ amplitude to Input A. Connect a 1kHz sine-wave with $1.2V_{pp}$ amplitude to Input D on the rear panel. Approx 120000 should be displayed.

Check of the FREQUENCY AVERAGE function

Press the FREQ pushbutton. Set slide switch E on the rear panel to position FREQ A AVERAGE. Connect a 120MHz sine-wave with $50mV_{pp}$ amplitude to Input A. Set the measuring time to 1s. The display read-out should be 120.XXXXX MHz.

Connect the signal below to Input E.



The display read-out should be 120.XXX MHz. Note that the result now is approx 0.2% higher.

Refer to the Operating Manual for more information about frequency average measurements.

Check of the COUNT function

Press the COUNT A and ⊓⊔ pushbuttons. Connect a pulse generator with "single shot" pulses with 50ns duration and $20mV_{pp}$ amplitude to Input A. Check that the counter counts correctly when single pulses are generated. Disconnect the pulse generator.

Press DISPL HOLD, RESET and then CHECK. Release DISPL HOLD. The counter should now start counting. Stop the counting by pressing DISPL HOLD. Press RESET. The display read-out should be 0.

Check of MEASURING TIME

Press the MEASURING TIME knob and rotate the knob. Check that the displayed measuring time corresponds with the scale.

Check of Input B (PM 6674...76)

Press the Input B pushbutton on the front panel. Connect a sine-wave to Input B and check that the counter counts correctly according to the following table.

Model	Frequency	Signal level
PM 6674	50...550MHz	-27 dBm
PM 6675	100...500MHz 50...600MHz	-33 dBm -27 dBm
PM 6676	100...1000MHz 1500MHz	-27 dBm -17 dBm

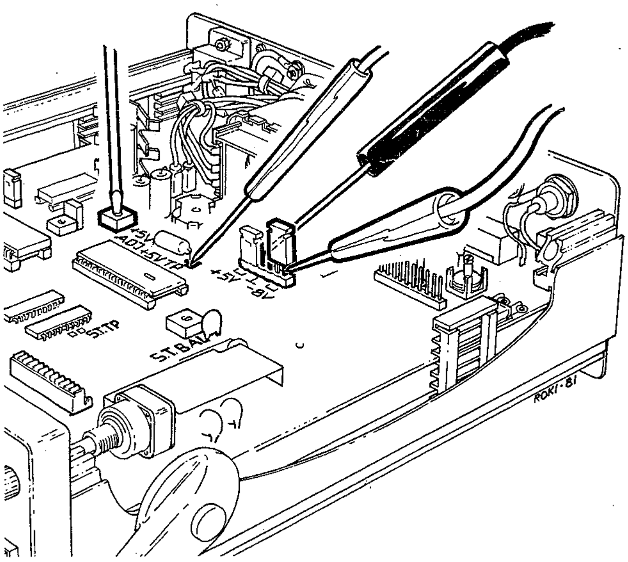
3. ADJUSTMENTS

Required test equipment

- Voltmeter, e.g. Philips PM 2517
- RF Signal Generator, e.g. Wavetek 2002A
- Sampling Oscilloscope, e.g. Philips PM 3400
- Frequency counter, e.g. Philips PM 6667

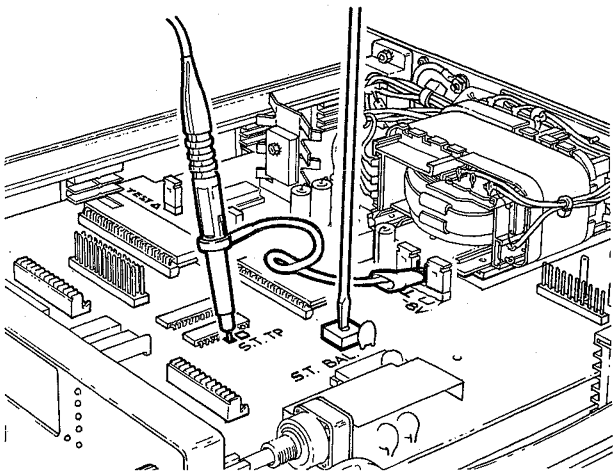
DC Voltage

- Connect a voltmeter between +5V TP and earth.
- Adjust R1188 (+5V ADJ) to 5.0V ± 0.05V.
- Connect the voltmeter to BU110:1 (-8V) without removing the jumper. Check that the voltage is 8.0V ± 0.5V.



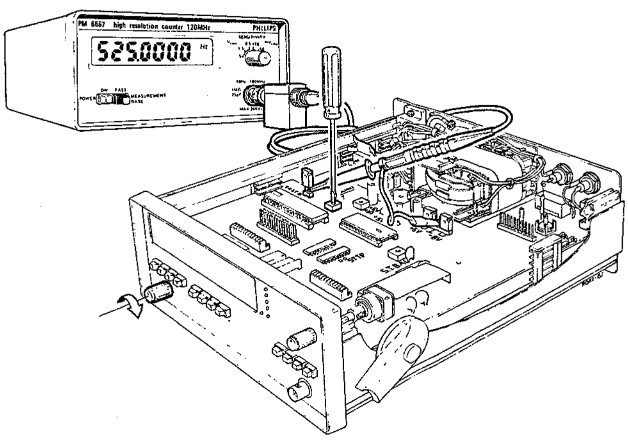
Schmitt Trigger Balance

- Connect a 1kHz sine-wave with 30mV$_{pp}$ amplitude to INPUT A.
- Press the ⊓⊔ pushbutton.
- Set SENSITIVITY to 10mV.
- Connect an oscilloscope to the test point S.T. TP.
- Adjust R1025 (S.T. BAL) until the displayed square-wave has a duty factor of 0.50.



Measuring Time

The measuring time adjustment is performed with an universal counter equipped with a LF probe. Set this testing counter to measure frequency with a sensitivity of approx 1V$_{pp}$ referred to the probe tip.



- Connect the LF probe to the connector labelled TEST without removing the jumper.
- Turn the potentiometer R1164 (MEASURING TIME ADJUST) fully anti-clockwise.
- Turn R1 (MEASURING TIME) fully clockwise.
- Turn the potentiometer R1164 slowly clockwise until the testing counter measures 522 ± 4Hz.

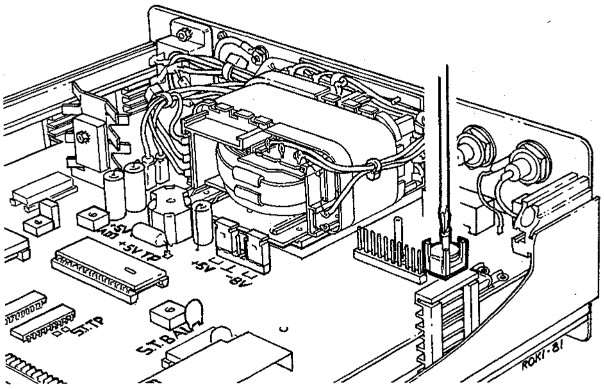
If the MEASURING TIME ADJUST potentiometer is turned too far clockwise, the counter under test will run into the self-test mode. The display read-out is then a test code. To exit the self-test mode, ensure that the MEASURING TIME ADJUST potentiometer is correctly adjusted before pressing RESET.

Frequency Adjustment of the Standard Oscillator (01 version)

This adjustment is performed at an ambient temperature of approx 23°C after a warm-up period of one hour.

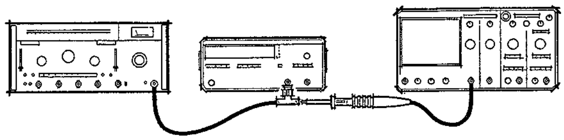
Proceed as follows:

- Connect a 10MHz reference signal with a tolerance of $<1 \times 10^{-6}$ to Input A.
- Press the FREQ and ⊓⊔ pushbutton.
- Select correct SENSITIVITY by increasing the control until a stable read-out is obtained.
- Set the MEASURING TIME to 1s.
- Adjust trimmer C1154 with an isolated trimming screw driver until the read-out on the display is 10000.000kHz ± 10Hz.

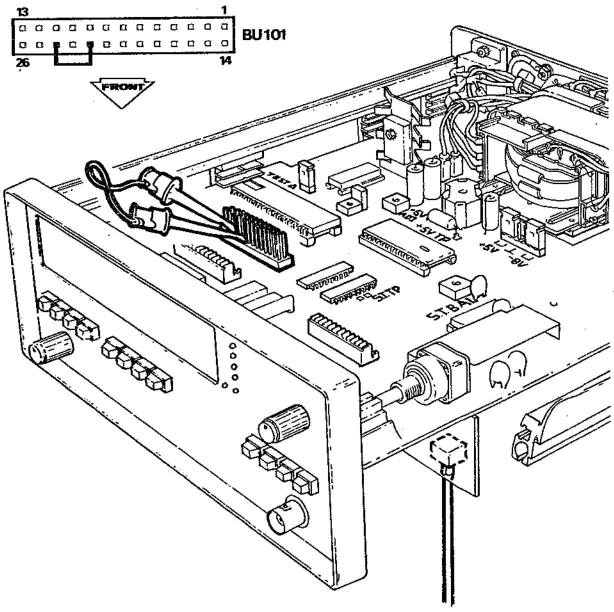


PM 6674 Prescaler

- Connect an RF signal generator with a frequency range of 10...600MHz to Input B, together with a sampling oscilloscope.



- Set the RF generator frequency to 550MHz at -29dBm.
- Adjust the reference voltage potentiometer R316 on Unit 3 so that the counter starts to count the 550MHz signal. The part of the prescaler that makes the counter display only zeros, when the signal amplitude to Input B is below specification, is called the Enable Function. To disable this function, connect BU101:24 (TEST) to BU101:22 (+5V).



- Set TEST high, and check the sensitivity when the display shows a correct, stable result. The difference in sensitivity between TEST high, and TEST low should be greater than 2dB.
- Check the sensitivity at 400MHz and 50MHz in the same manner

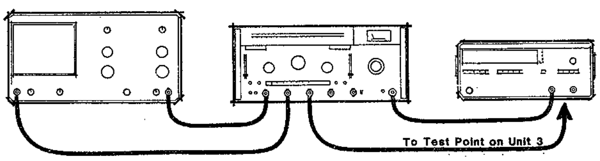
PM 6675 Direct Gated Input

The test procedure is the same as for the prescaler in PM 6674, but with the following changes.

- Set the RF generator frequency to 500MHz at -35dBm output level.
- Adjust the reference voltage with potentiometer RV301.
- The difference in sensitivity between TEST high and TEST low should be greater than 1dB.
- Check that the sensitivity is -33dBm for 100...500MHz and -27dBm for 50...600MHz.

PM 6676 Prescaler

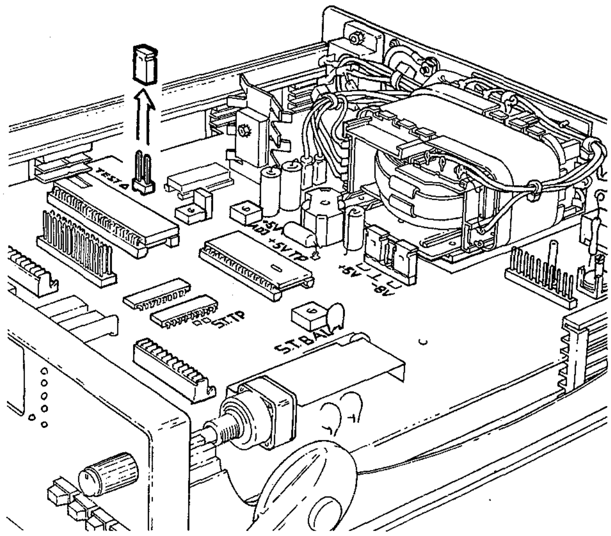
- Connect an RF signal generator with a 1500MHz frequency range to Input B.
- Set the generator output level to -30dBm.
- Connect the vertical output of the generator to channel Y_A and the horisontal output to channel Y_B of the sampling oscilloscope (set to 0.1V/div and X/Y mode).
- Connect a coaxial cable between the test point connector on the prescaler board and DEMOD IN on a Wavetek 2002A.



- Adjust C308 and C318 for max output at 1500MHz. The output level at 1200...1400MHz may not be lower than at 1500MHz.
- Connect BU101:22 to BU101:24.
- Measure at which input level the counter counts correctly at 100, 200, 1000 and 1500MHz.
- Remove the connection between BU101:22 and 24.
- Adjust R333 to -30dBm sensitivity at 1000MHz. The difference in sensitivity between TEST high and TEST low should be greater than 1dB.
- Check the sensitivity at 100, 200, 900 and 1500MHz. The sensitivity should be -27dBm for 100...1000MHz and fall to -17dBm at 1500MHz.
- Connect 50MHz to Input B with as large amplitude as possible, but max $12V_{RMS}$. Check that the counter measures correctly.

4. SELF-TEST

The counters of the PM 6673...76 series, each have a built-in self-test facility, which complements the CHECK function available on the front panel. This facility provides a test of the communication between the microcomputer and the function selector switches on the front and rear panels, and also the communication between the microcomputer and the display.



The test procedure is as follows:

- Remove the jumper labelled TEST.
- Release all pushbuttons.
- Press the POWER pushbutton.
- Press the RESET pushbutton.
- Ensure that FREQ A AVERAGE is not selected on the rear-panel slide switch.

MODEL	SELECT				DISPLAY READ-OUT								
PM 6673... 76	No controls selected. FREQ A AVERAGE not selected on the rear panel.				MSD								LSD
					0	0	0	0	0	1	0	0	0
PM 6674	Input A					0							
	Input B					1							
PM 6675	Input A					4							
	Input B					5							
PM 6676	Input A					2							
	Input B					3							
PM 6673... 76	PUSH TO READ								1				
	DISPL HOLD							1					
	FREQ A AVERAGE						1						
	COUNT A	RATIO to D	PERIOD A	FREQ									
	Pushed											0	0
	Pushed	Pushed										4	1
	Pushed	Pushed	Pushed									4	1
	Pushed	Pushed	Pushed	Pushed								4	1
	Pushed		Pushed	Pushed								0	0
	Pushed			Pushed								0	0
	Pushed		Pushed									0	0
		Pushed										0	1
		Pushed	Pushed									0	1
		Pushed	Pushed	Pushed								0	1
		Pushed		Pushed								0	1
			Pushed									2	1
			Pushed	Pushed								5	0
				Pushed								1	0

Table 4.1 Self-test sequence. Only digits of interest (position and value) are indicated.

5. TROUBLE-SHOOTING

The following points will help trouble-shooting the PM 6673...76 series of counters.

- First check that the procedures in the Operating Manual, section Practical Measurements have been followed. Take particulary notice of the slide switch settings on the rear panel.
- Check that +5V is present at the +5V test point and that -8V is present at BU110:1.
- Make the self-test as previously described. If the self-test gives an erroneous result for a particular function, check the corresponding circuit and switch for that function.
- If the self-test functions correct, the fault is probably in the input circuits, in the external main gate network or in 0Q0040. IC140...142, IC160 and 0Q0040 can be tested by the CHECK function. Using the following sequence, circuits are gradually added which makes it easier to find the fault.

  1. Count: IC141C and IC161:1 are used.
  2. Period: IC141C, IC161:1 and the 10MHz standard are used.
  3. Frequency (reciprocal): IC160, IC142D, IC161:28 and the 10MHz standard are used.
  4. Frequency (conventional): more complicated to trouble-shoot, as an external main gate is used. IC140, IC141C, IC142C+D and IC160 are used.
  5. Ratio: as conventional frequency, but use an external signal via Input D.

For trouble-shooting, the ratio mode is sometimes better than the frequency mode because it is possible to use a low frequency signal. This makes it easier to display the signal TRIGG, IC161:4 on an oscilloscope.

IC141A can be tested by connecting a signal to Input A. IC141B is used for Input B signals. Make the tests in the 1...5 sequence above (only 3...5 for Input B).

- If the display makes no sense at all, check the microcomputer signal ALE (IC162:11) with an oscilloscope. The pulse width should be approx 0.7us and the pulse space approx 2.3us.
- If there is no ALE output, check that +5V is present at pin 26 and 40 of IC162. Measure to ground of the microcomputer (pin 20). Check that the oscillator signals at pin 2 and 3 of IC162 are correct, i.e. 5MHz. Replace the microcomputer if the oscillator signals are correct, but the ALE signal is not.
- If a correct ALE signal is present at pin 11 of the microcomputer, check the signals as illustrated in Fig. 5.1. It is difficult to get a steady display on an oscilloscope, so these figures are only a schematic illustration of the display.

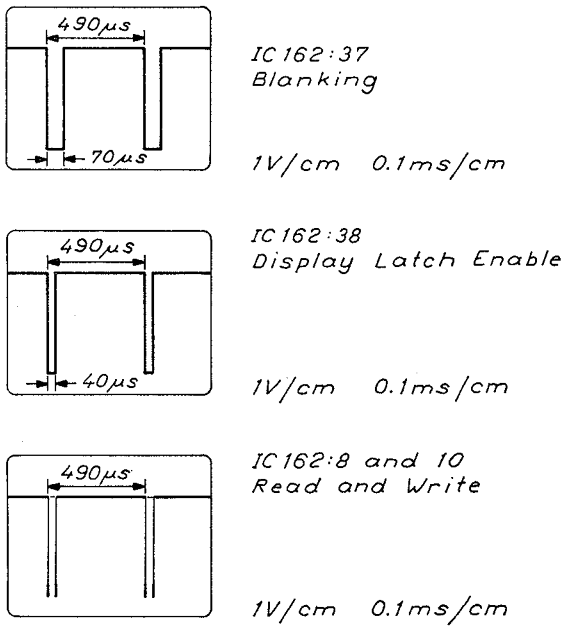


Fig. 5.1 If ALE is correct, check these signals.

Notes to Fig. 5.1:

- Trigg on IC165:1, negative slope, pulse duration = 0.5ms and pulse space = 3.8ms.
- At IC162:37, every 9:th pulse has longer duration.
- At IC162:38, every 9:th pulse has 90us duration.
- At IC162:8 and 10, every 9:th group of pulses consists of 3 pulses. The pulse duration is approx 1us.

If the microcomputer signals are correct as illustrated in Fig 5.1, continue with checking IC164, see Fig. 5.2.

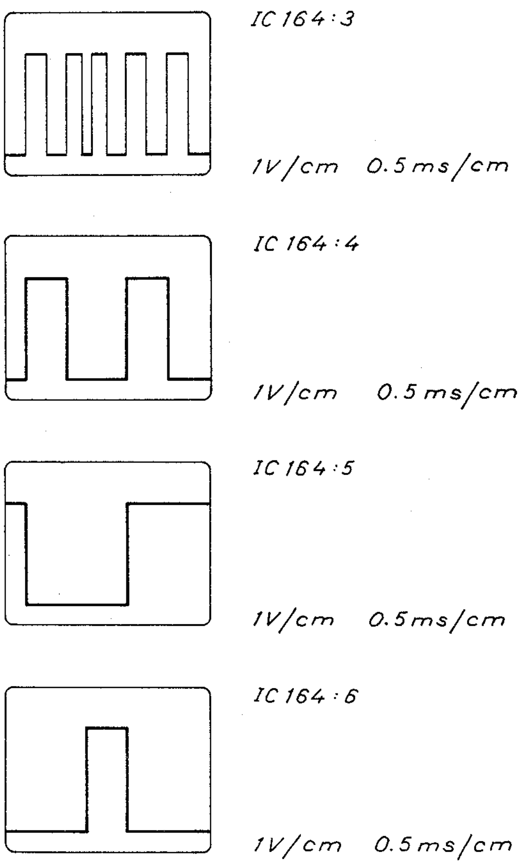


Fig. 5.2 Signals to check on IC164.

The power supply

A fault in the power supply can be isolated easier if the counter circuits are disconnected by removing the two jumpers on BU110. However, to simulate the load, a dummy load has to be used.

- Connect a 5 ohm,<5W resistor between BU110:1 and BU110:3.
- Connect a 50 ohm, < 1.3W resistor between BU110:4 and BU110:6.
- The dummy load can be assembled by using a female connector, ordering number 5322 267 54102. Cut the connector to a suitable length.

First aid service kit

A kit containing components of interest for service is available. One each of the following components is supplied in the kit.

Component	Item number
LED display 7651, PM7773...76	B201...209
LED display 7651, PM6670...72	B201...208
Microcomputer 8049	IC162
Counter-on-a-chip 0Q0040	IC161
Display drive transistor MPS-A12	TS201...209
Seven segment decoder NE587N	IC201
Timer ICM 7555IPA	IC153
Input amplifier AM687DL, PM6670...72	IC102

The kit can be ordered from:

PHILIPS Elektronikindustrier AB
Industrial Operations
Supply Centre Service Department
S-175 88 JÄRFÄLLA
Sweden

Service Notes

The following hints apply only to counters with these serial numbers:

PM 6673: sn<1800	PM 6674: sn<1870
PM 6675: sn<1800	PM 6676: sn<1730

If there is no +5V output from the power supply, the following two hints might be of help.

1) The heat sink, on which transistor TS182 and diod GR183 are mounted, might cause a short circuit to ground. If necessary, either isolate the transistor and diod from the heat sink or make sure that the heat sink is not accidently connected to ground due to insufficent space on the foil.

2) If the optional oven enclosed oscillator PM 9679E is installed, check that the height of the pins on BU103 measured to the PCB is less than 11mm. If necessary, replace the connector with the type in the spare parts list.

New Seven Segment Decoder

In the first delivered counters, the Seven Segment Decoder consisted of two 9374PC (IC201 and IC202). These have now been replaced by a single NE587N (IC201) plus a 825 ohm resistor (R202). The new IC has better current capacity and the current through the segments are set by an external resistor (R202). It is not necessary to up-date an older version. However, the PCB is prepaired for the new IC and resistor.

- Remove IC201 and IC202.
- Remove the jumper from the IC socket.
- Install the NE587N in the IC201 socket.
- Mount a 825 ohm, 0.4W, 1% metal film resistor between pin 8 and ground.
- Connect pin 10 to ground.

Order number for the 9374PC: 5322 209 80955.

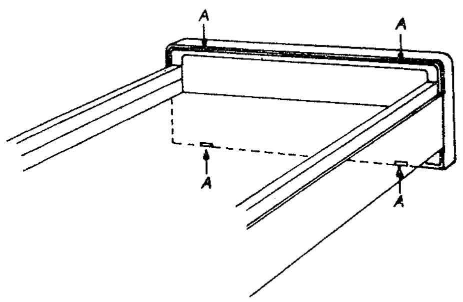
6. REPLACING PARTS

Molex contacts

- In the spare parts list, only a 13 pins contact is listed. However, the contact is easy to cut into required length.

Text plate and front rim

- Remove the knobs for Measuring Time and Sensitivity.
- Put a screw driver between the front rim and the front frame at points A as shown below.



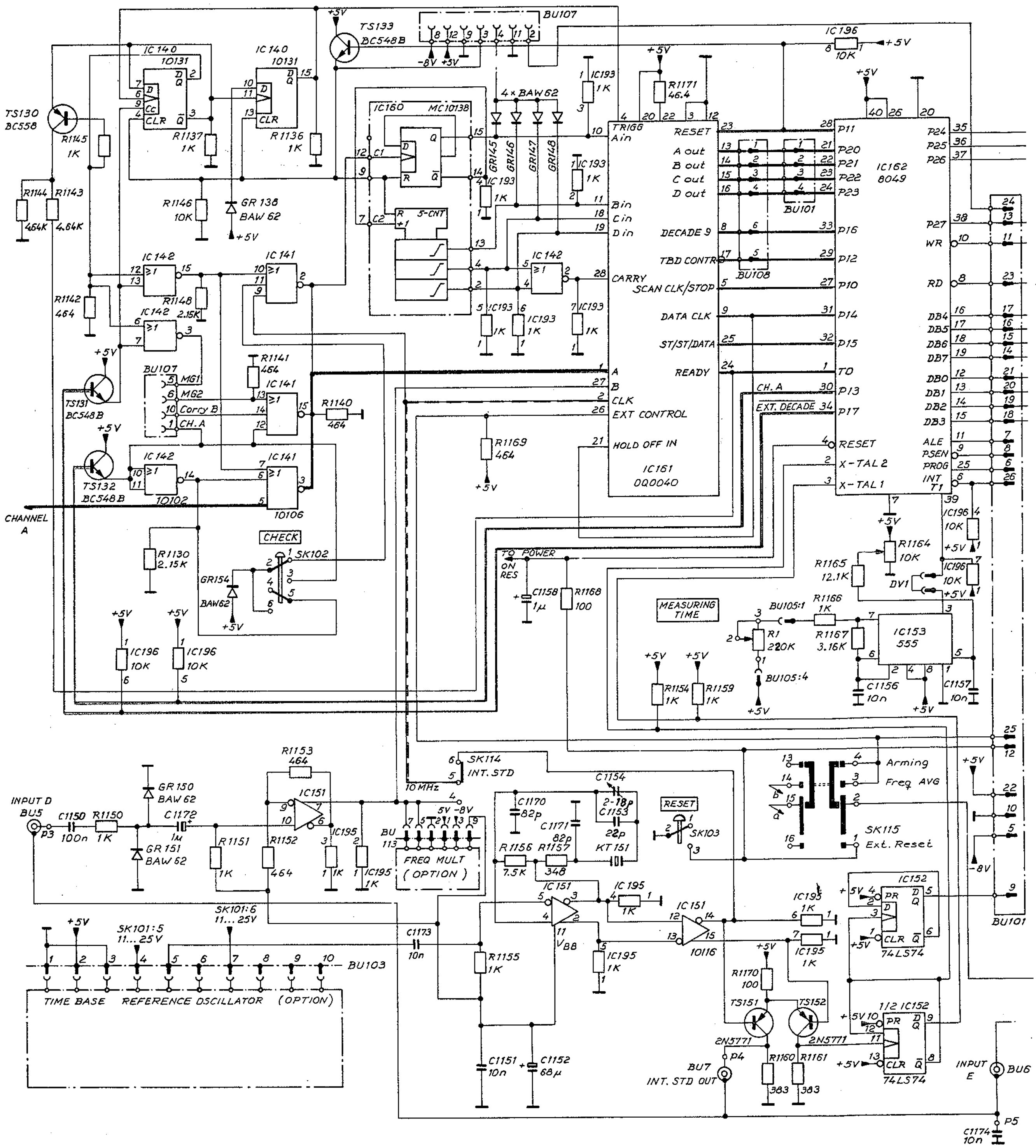
- Pry gently until the front rim comes off.
- Remove the text plate.

Handle

- Remove the two plastic knobs using a tiny screw driver or a pair of pliers.
- Unscrew the two screws and pull out the handle.
- Before assembling, grease the lock washer, screw hole and teeth of the handle very slightly with vaselin.

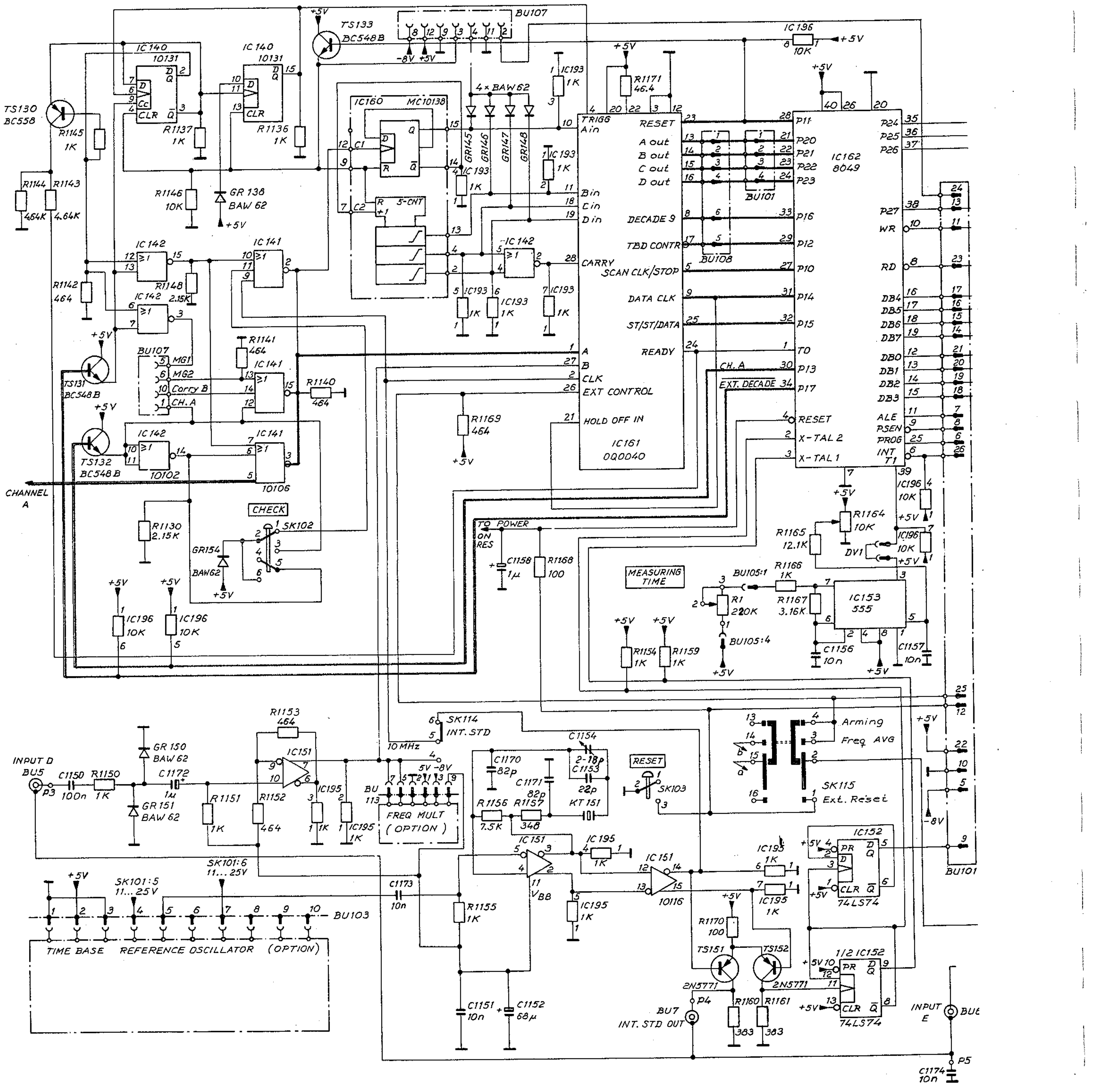
Power supply

- When replacing parts in the power supply, in particular IC180, check the +5V voltage. Refer to Section 3, Adjustments.



————	Signal to be measured
————	Control signal from the microcomputer
————	Respons signal to the microcomputer
-------	Internal 10MHz standard

Fig. 1.7 Period A measurement.

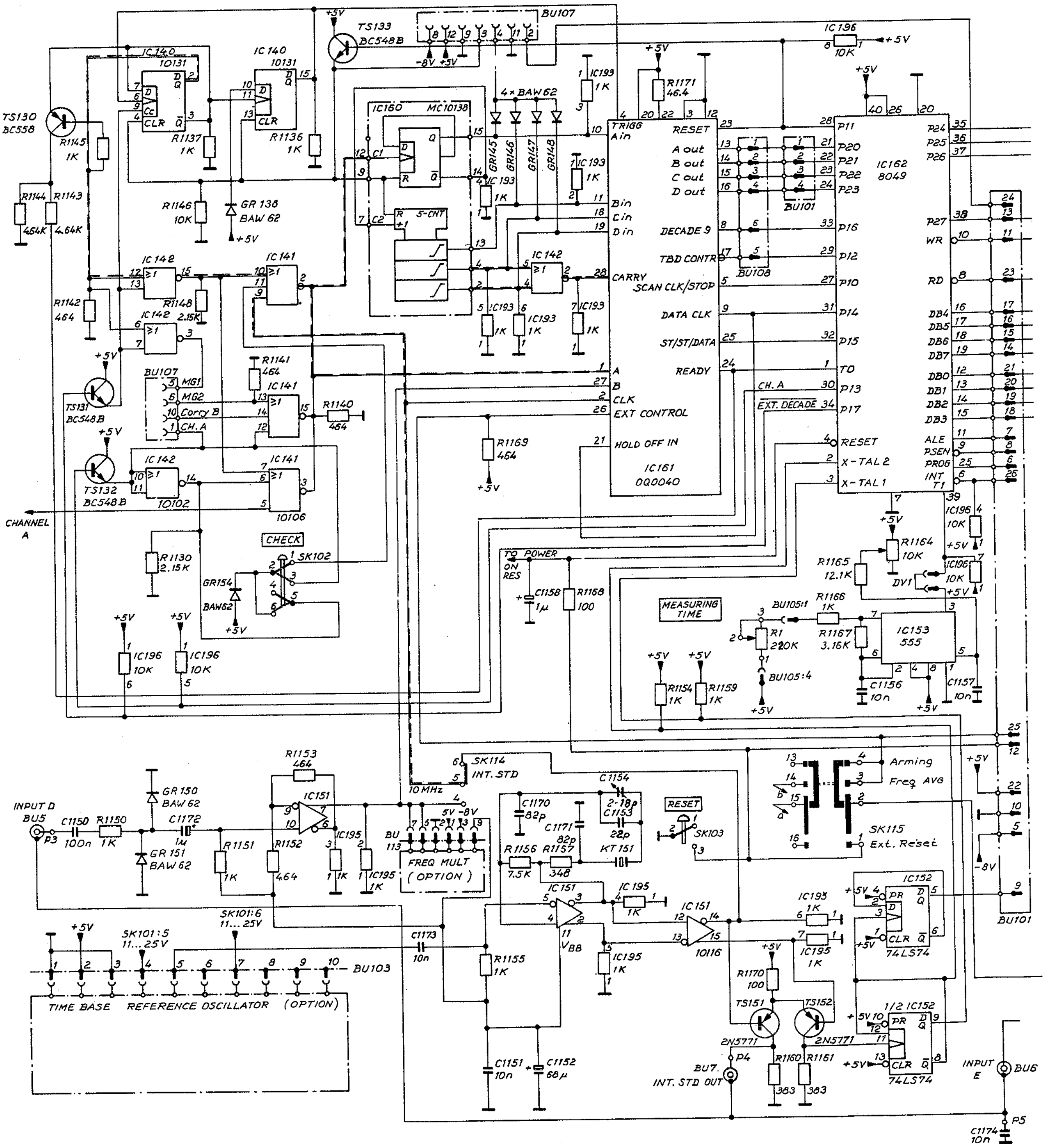


——————— Signal to be measured

——————— Control signal from the microcomputer

——————— Respons signal to the microcomputer

Fig. 1.8 Count A measurement.

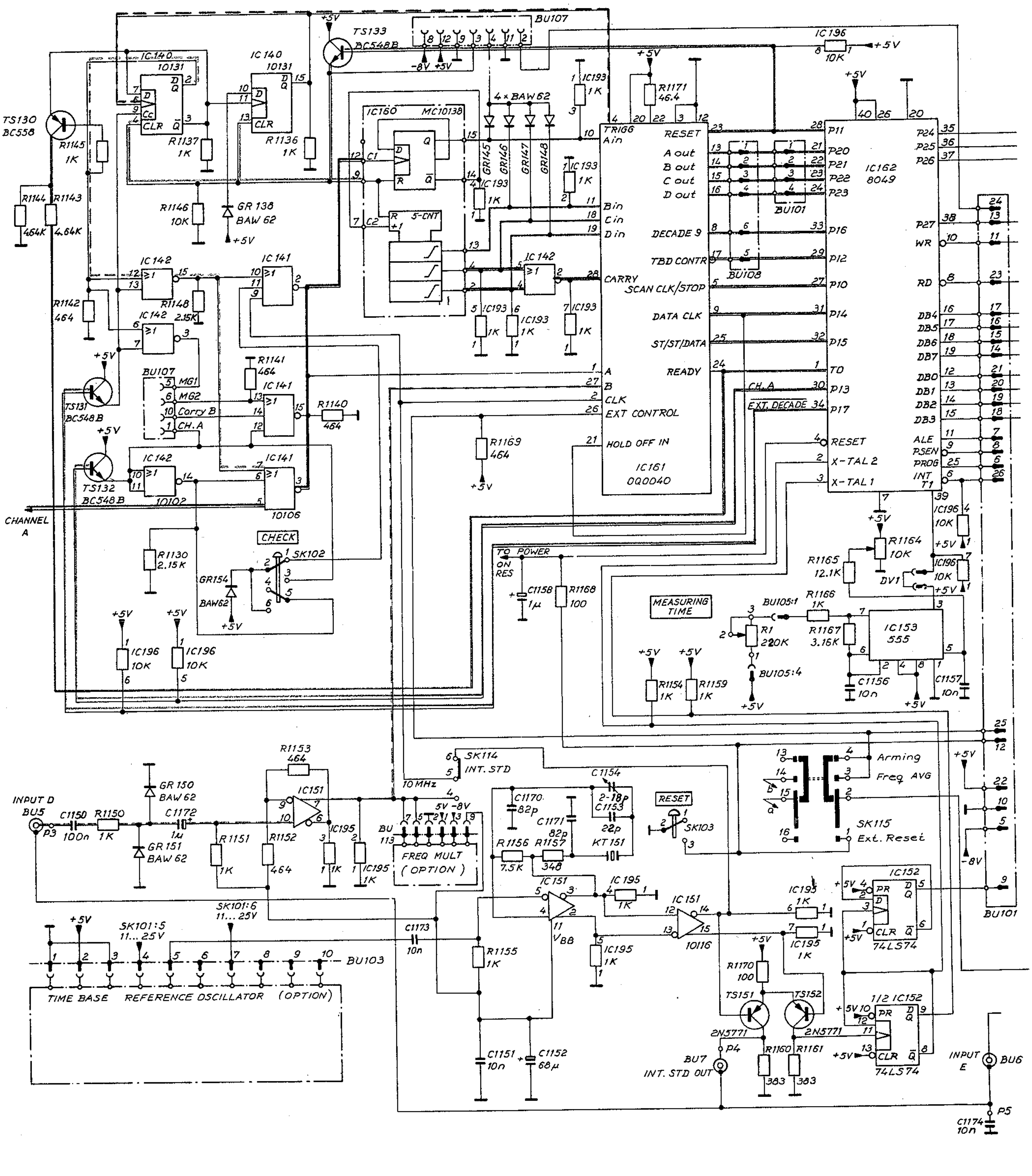


Internal 10MHz standard used as measurement signal

Main gate signal

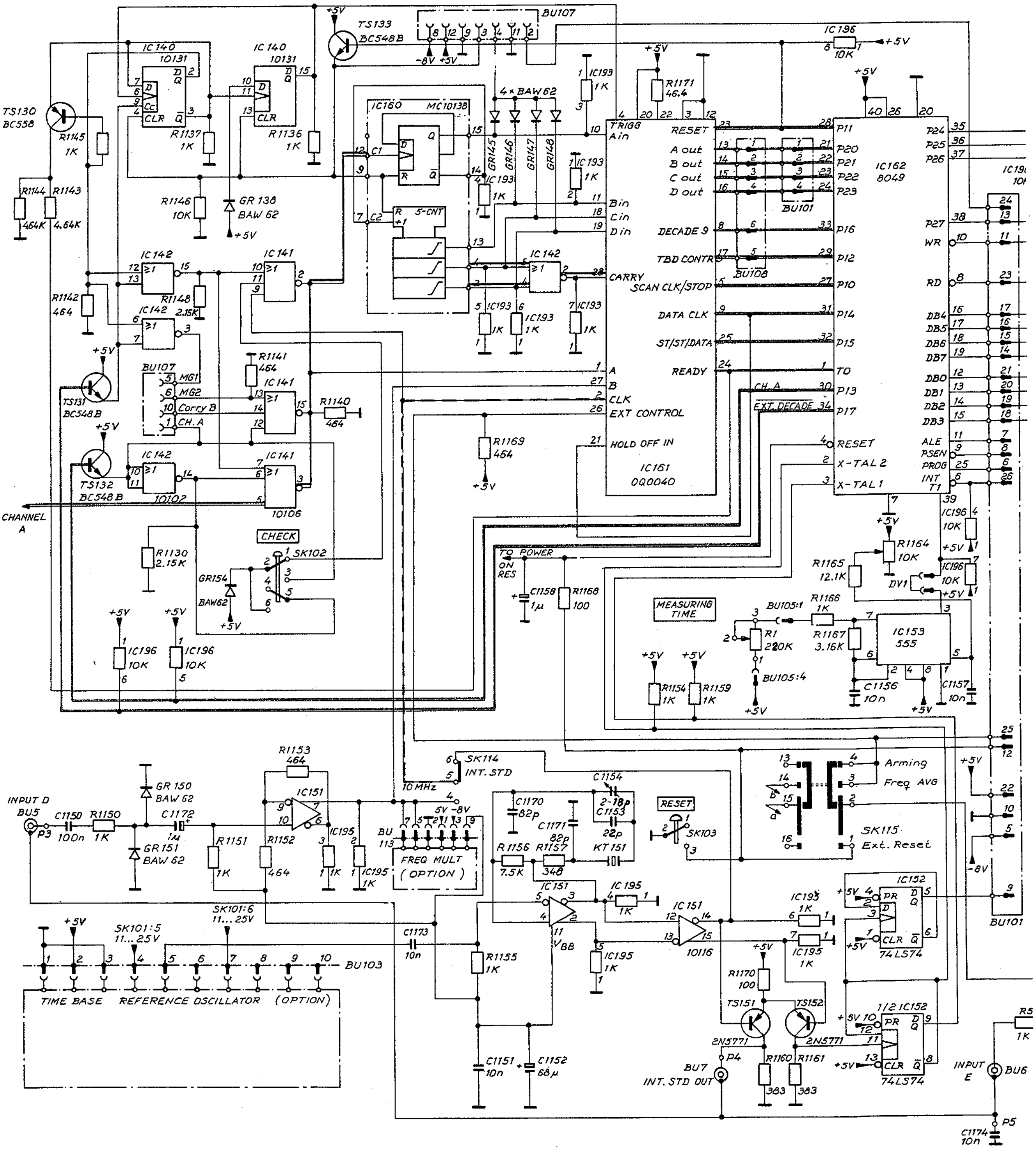
Internal 10MHz standard

Fig. 1.9 Check.



————————	Signal to be measured
– – – – – – –	Input D signal (reference)
- - - - - - -	Main gate signal
————————	Control signal from the microcomputer
————————	Respons signal to the microcomputer
— - — - — -	Trigger signal

Fig. 1.10 Ratio A/D measurement.



Signal to be measured

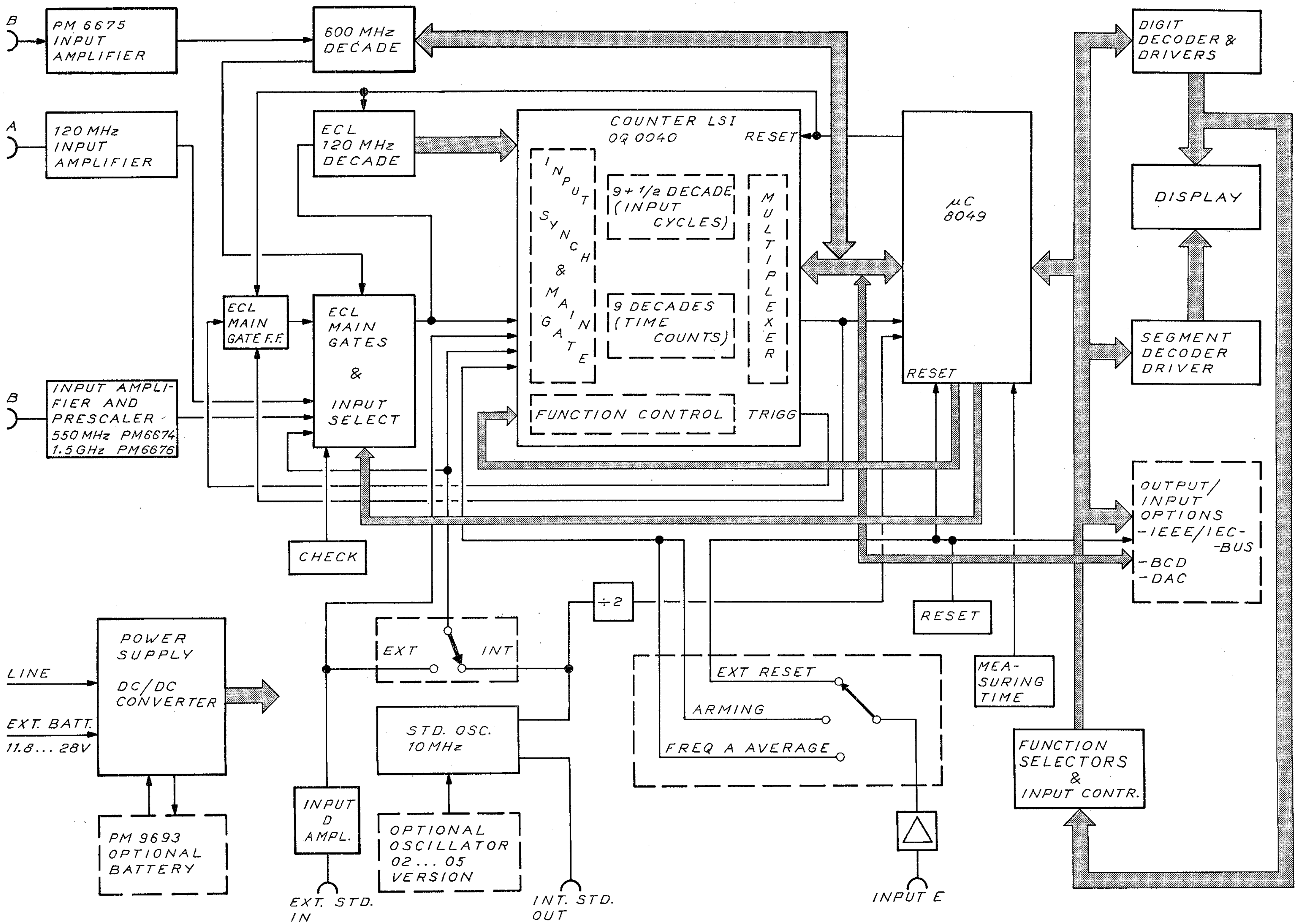
Control signal from the microcomputer

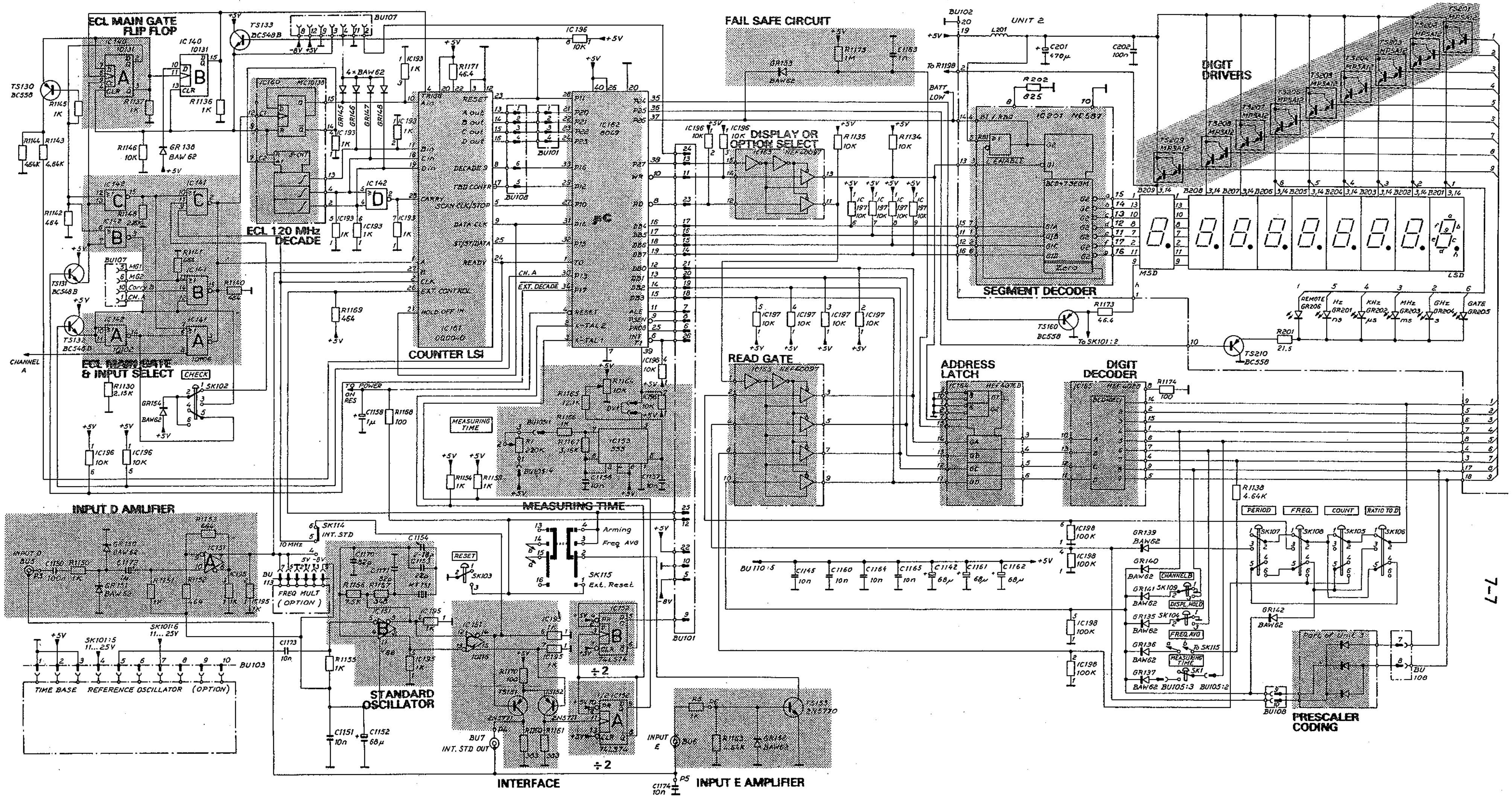
Respons signal to the microcomputer

Internal 10MHz standard

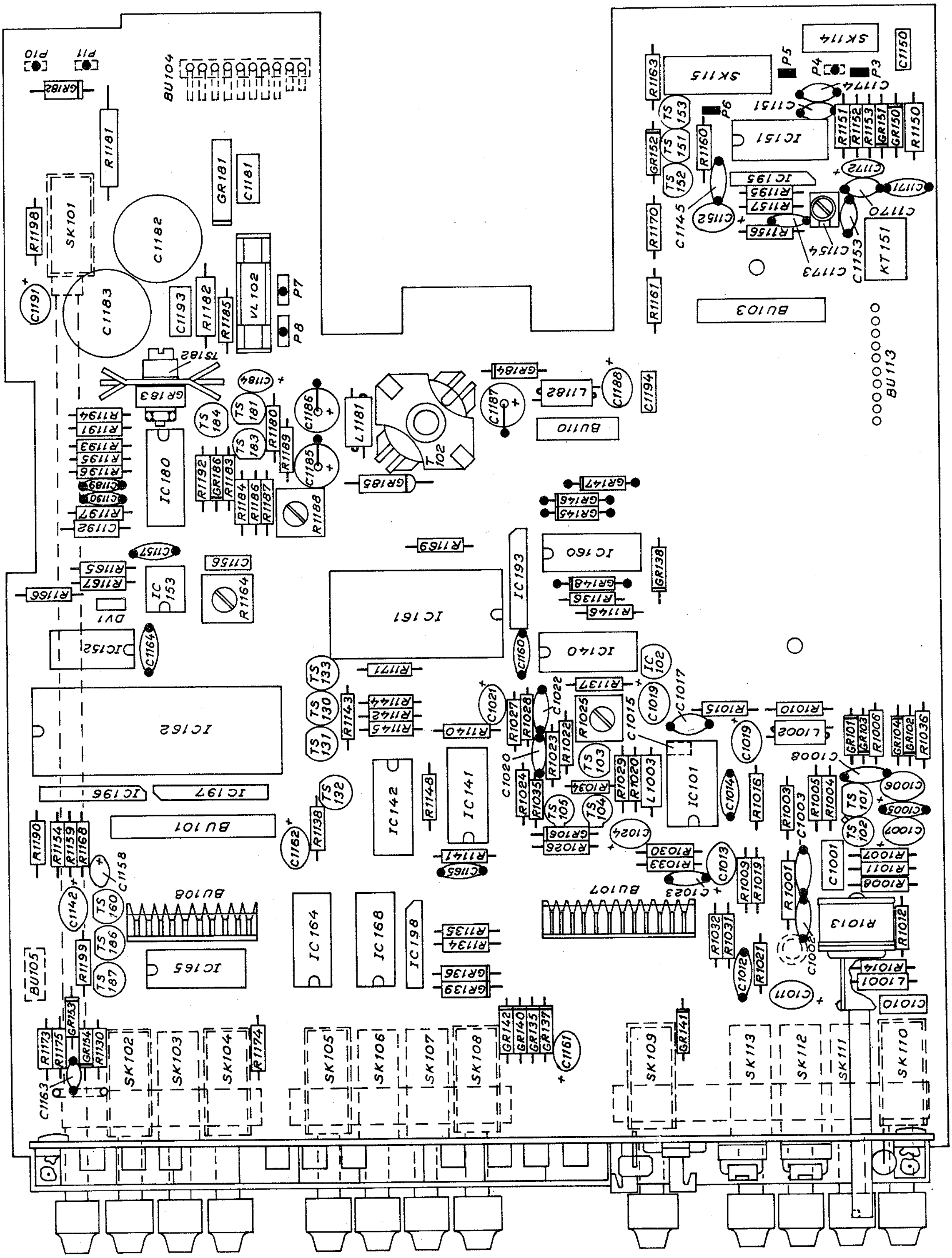
Fig. 1.11 Reciprocal mode.

Block diagram

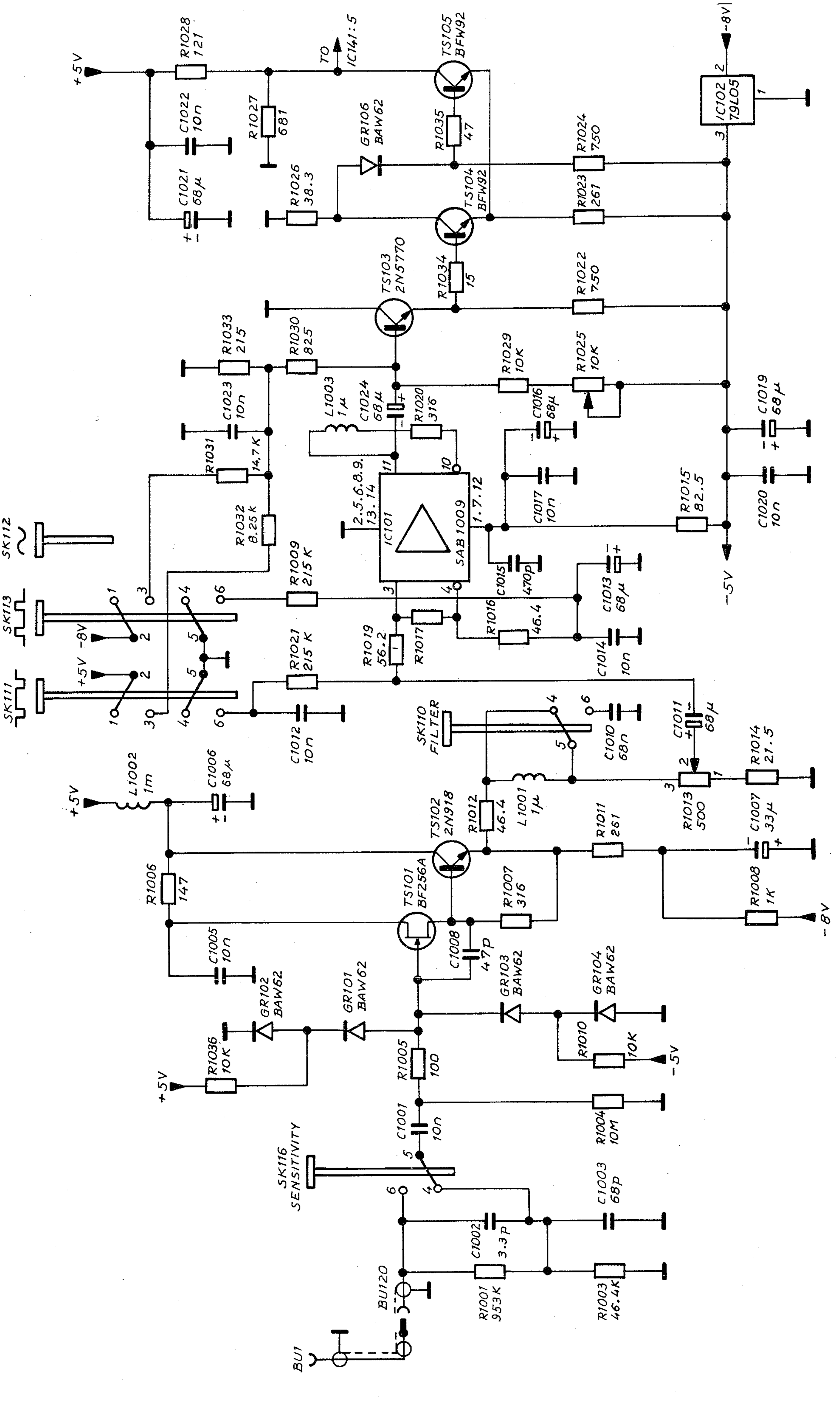




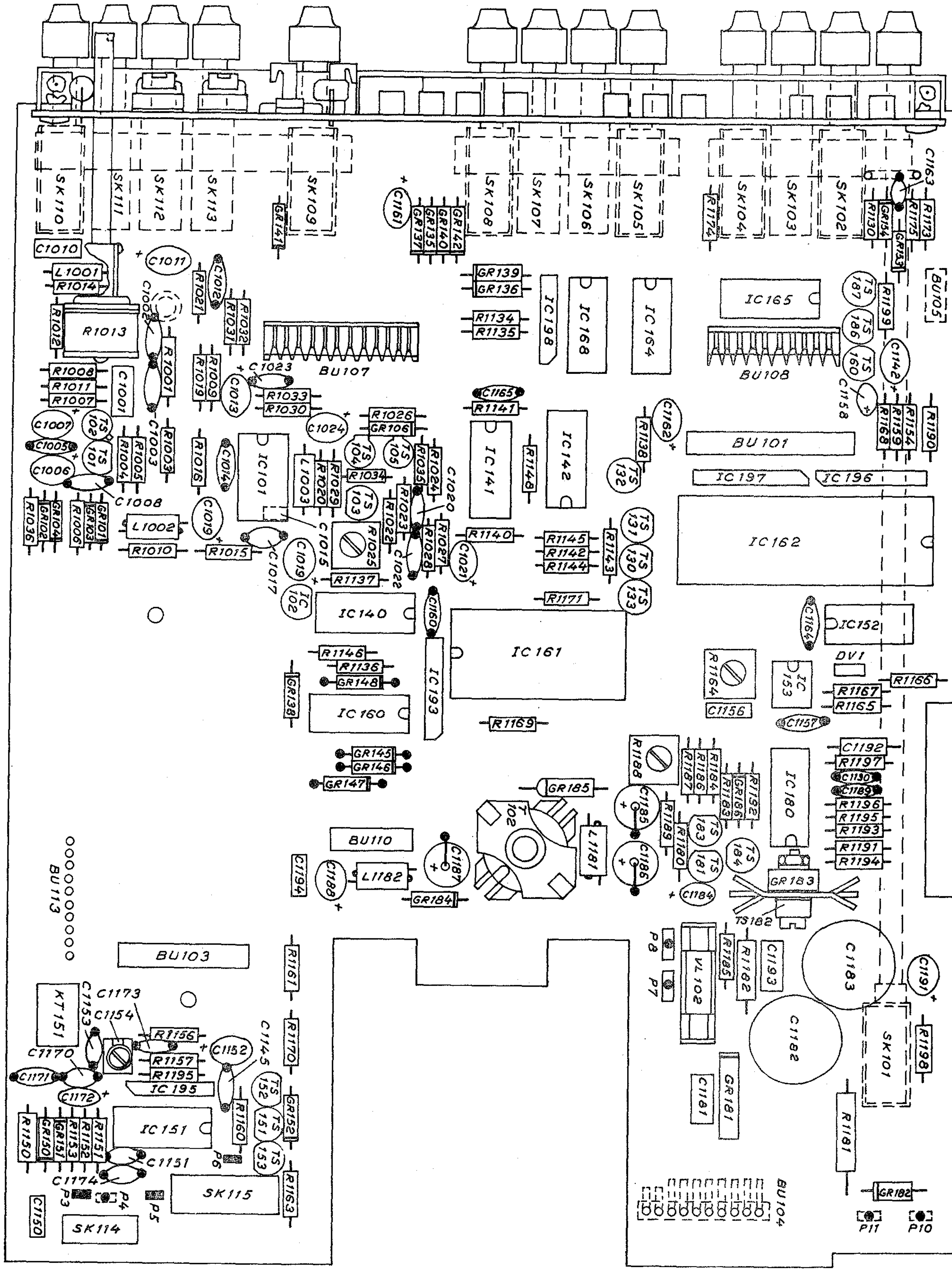
Functional block diagram



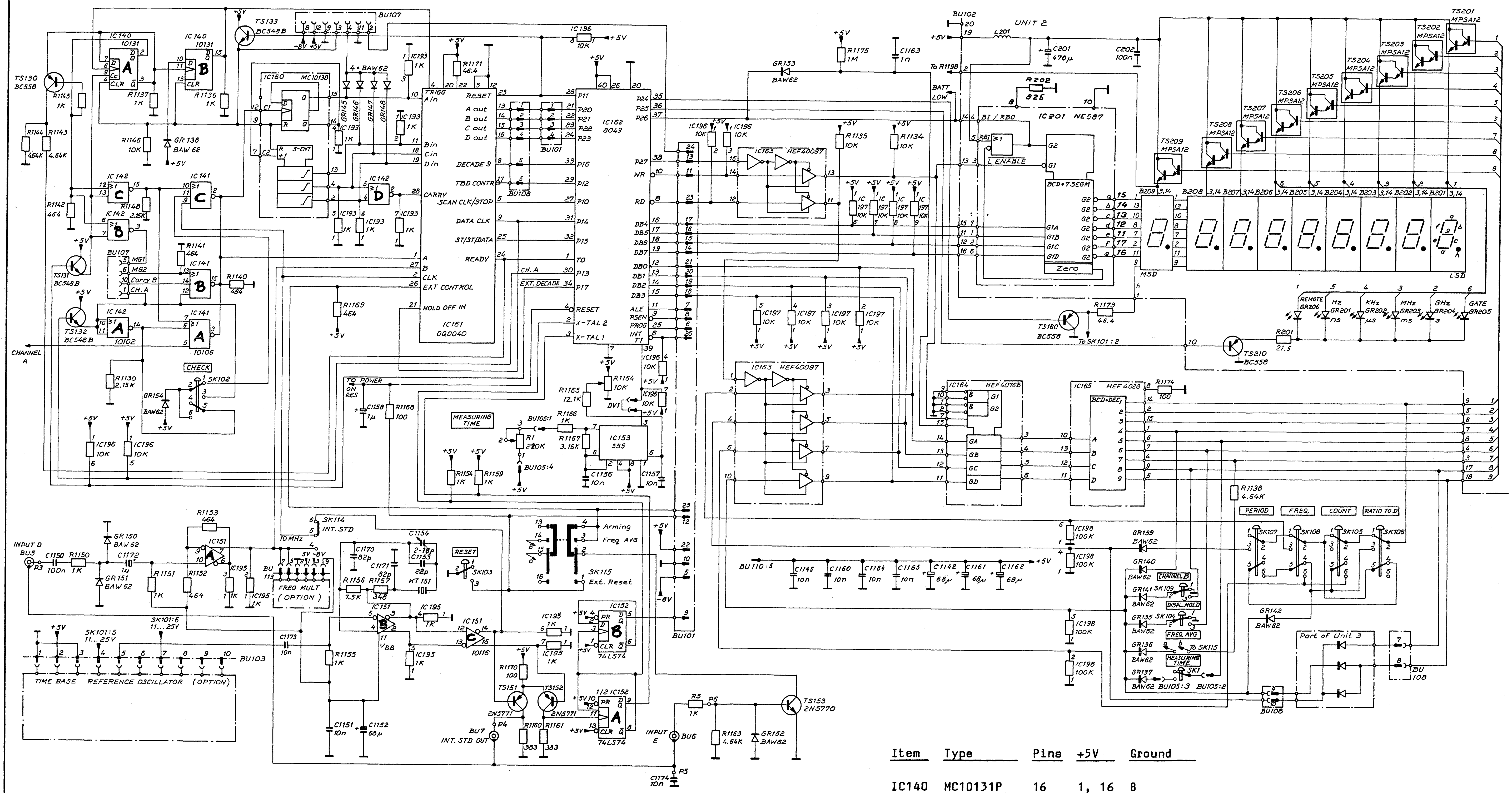
Input amplifier, logic and power supply



Input amplifier



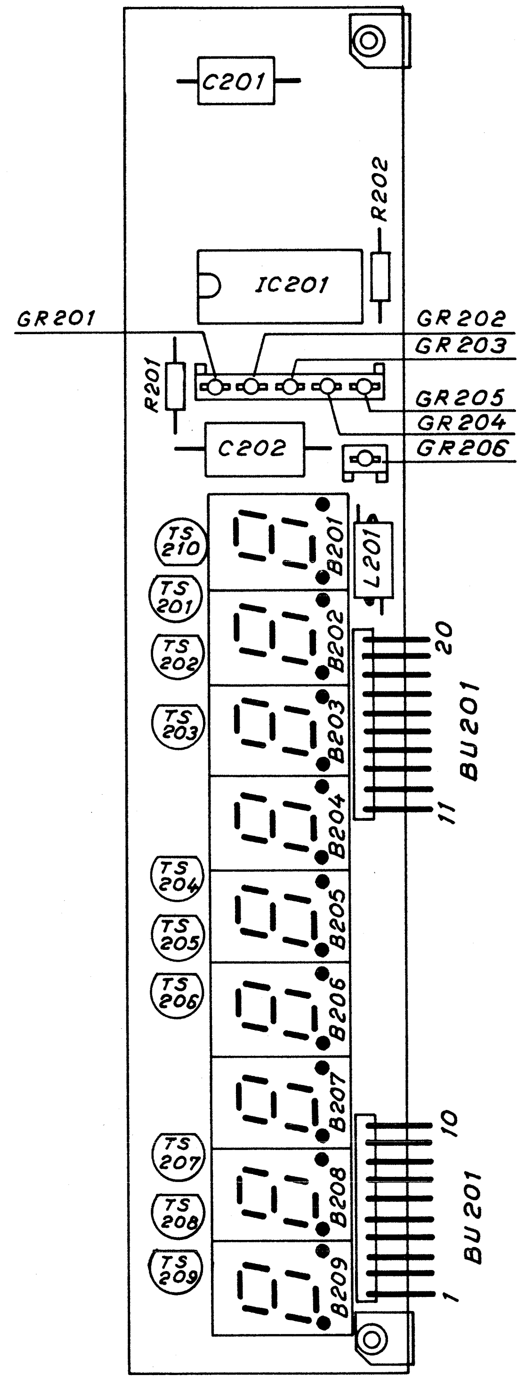
Input amplifier, logic and power supply



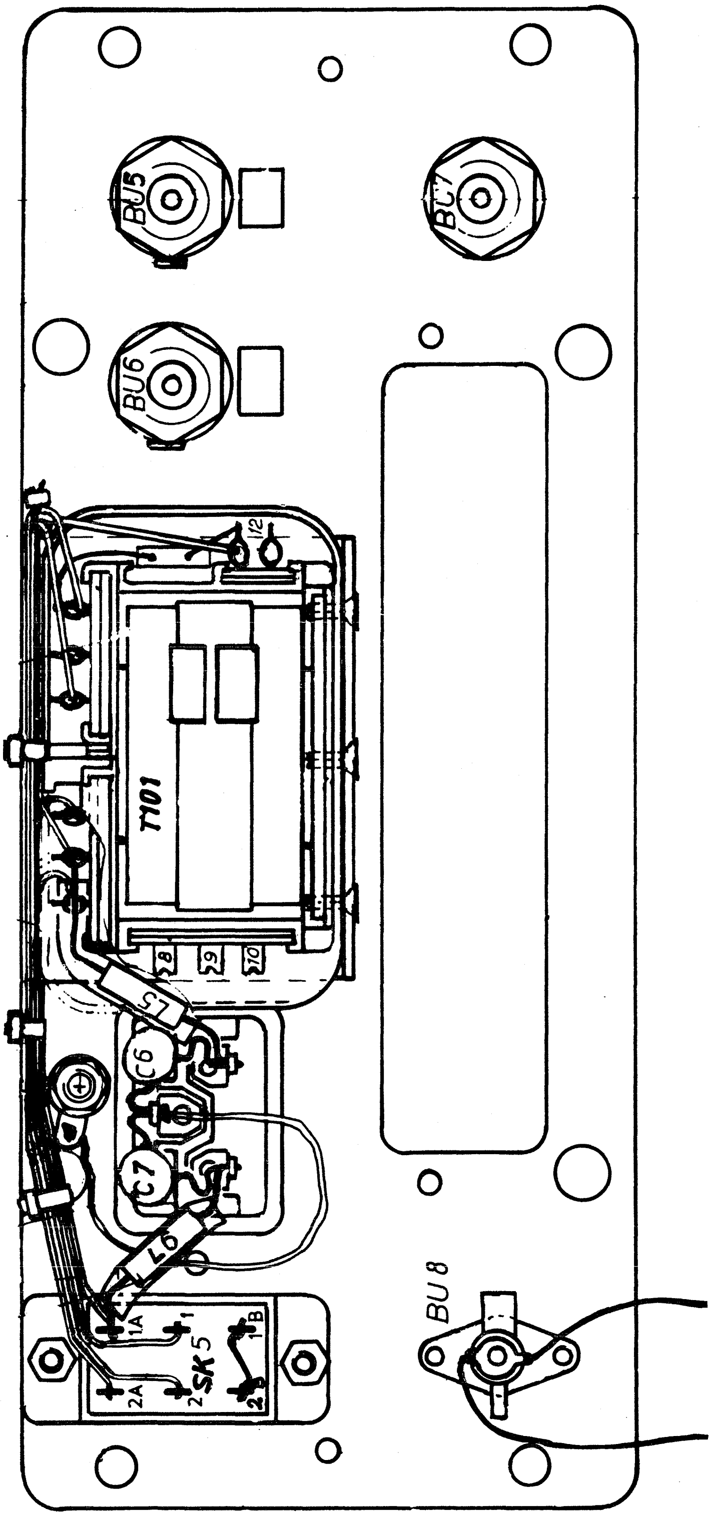
Item	Type	Pins	+5V	Ground
IC140	MC10131P	16	1, 16	8
IC141	GXB10106P	16	1, 16	8
IC142	MC10102L	16	1, 16	8
IC151	GXB10116P	16	1, 16	8
IC152	SN74LS74N	14	14	7
IC160	MC10138P	16	1, 16	8
IC163	HEF40097BP	16	16	8
IC164	HEF4076BP	16	16	8
IC165	HEF4028BP	16	16	via R1174
IC201	NE587N	18	18	9, 10

Note: To achieve a better performance at high temperatures, a diode GR155 of type BAW62 has been connected parallel to R1155 with its cathode towards C1155.

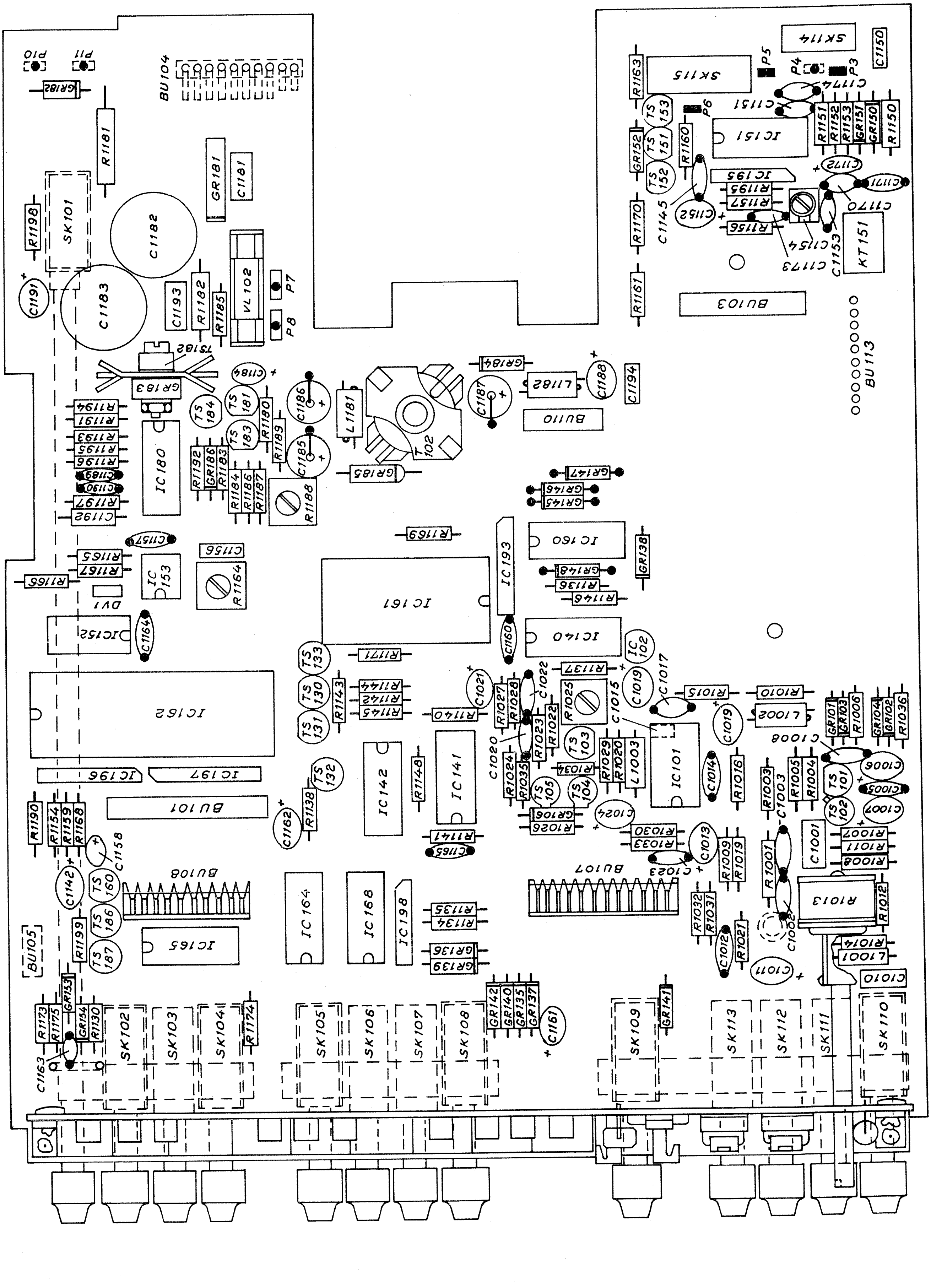
Display and logic



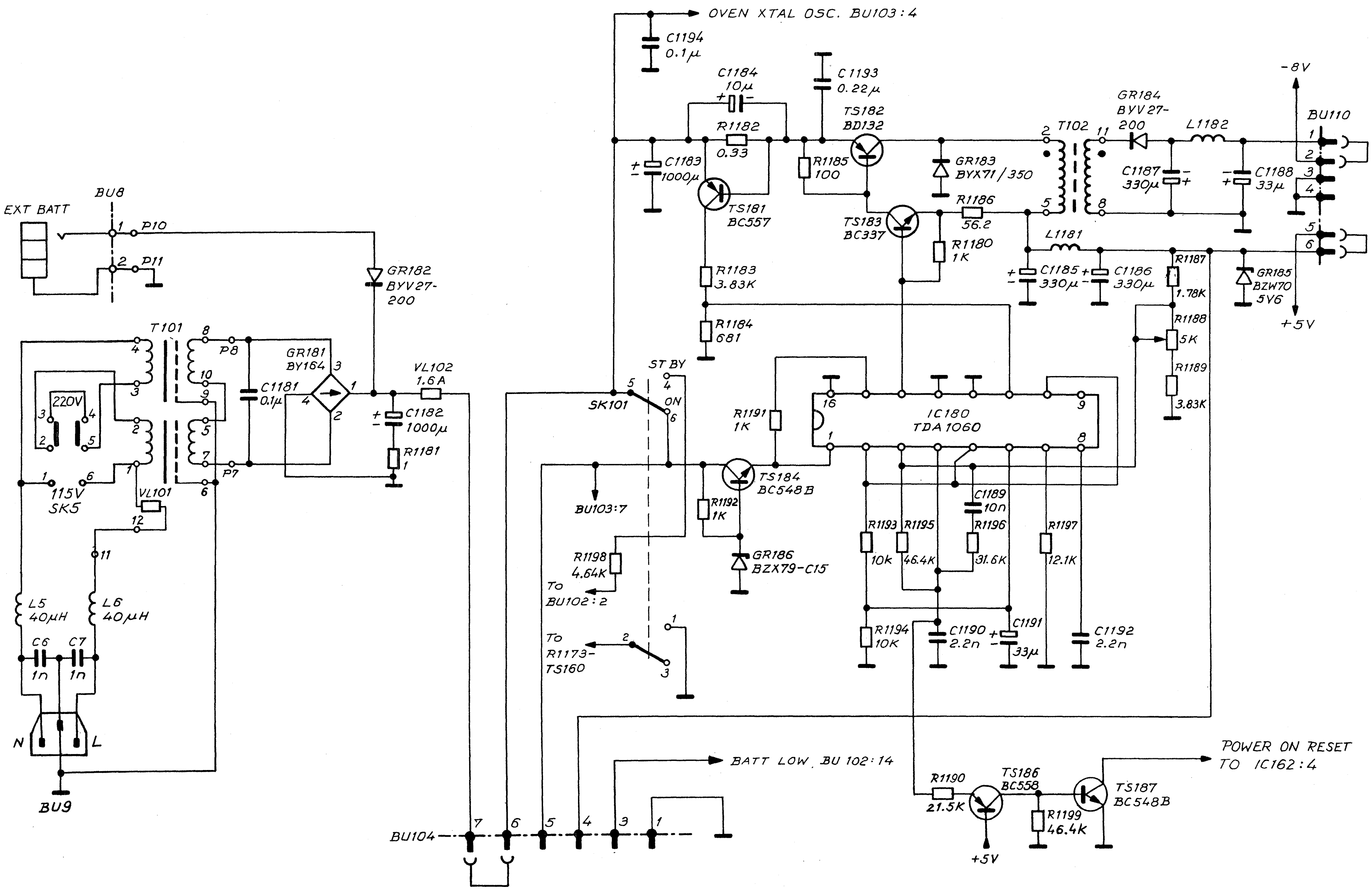
Mount the LED:s GR 201... GR 206
with the anode up towards R201



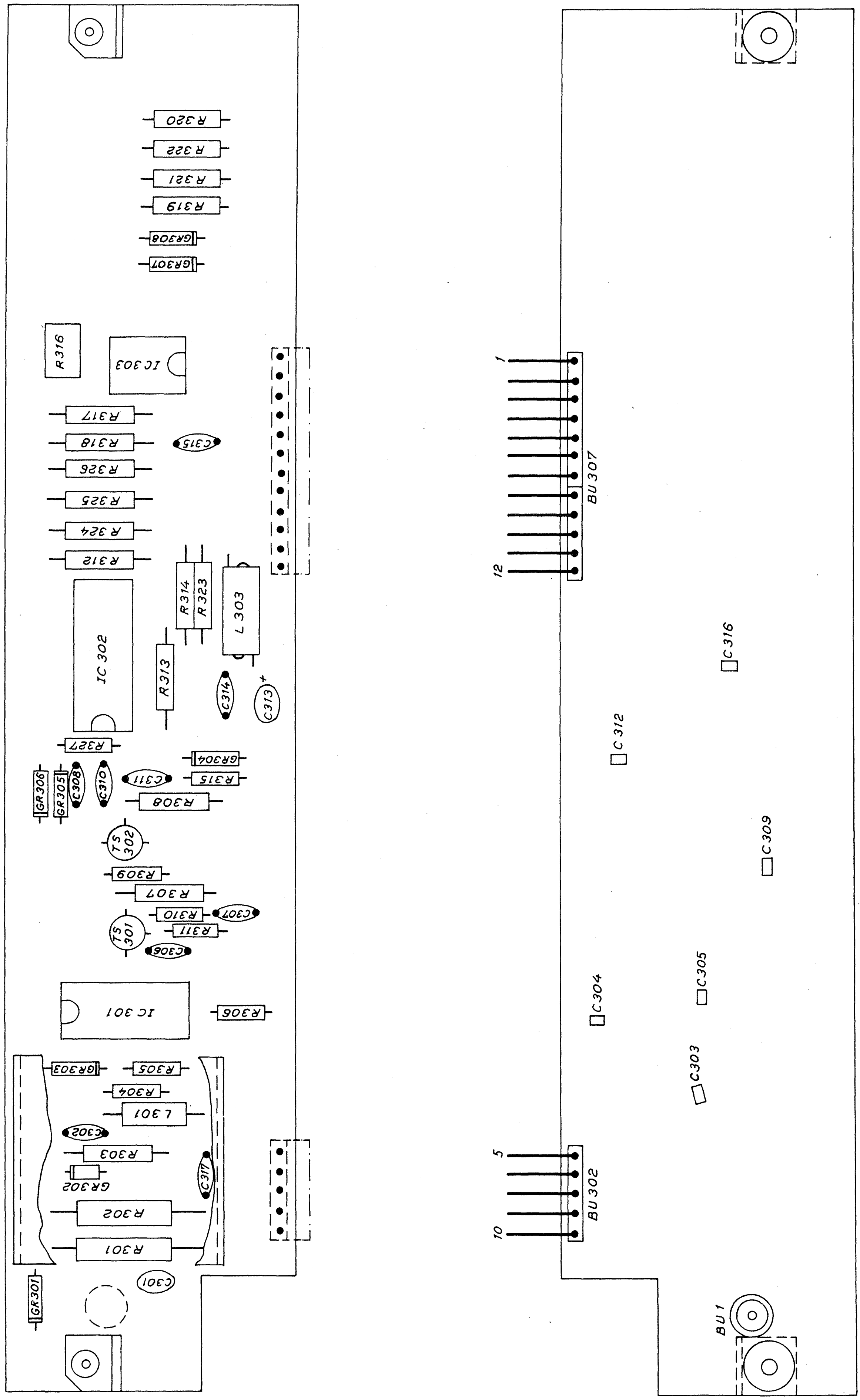
Rear panel



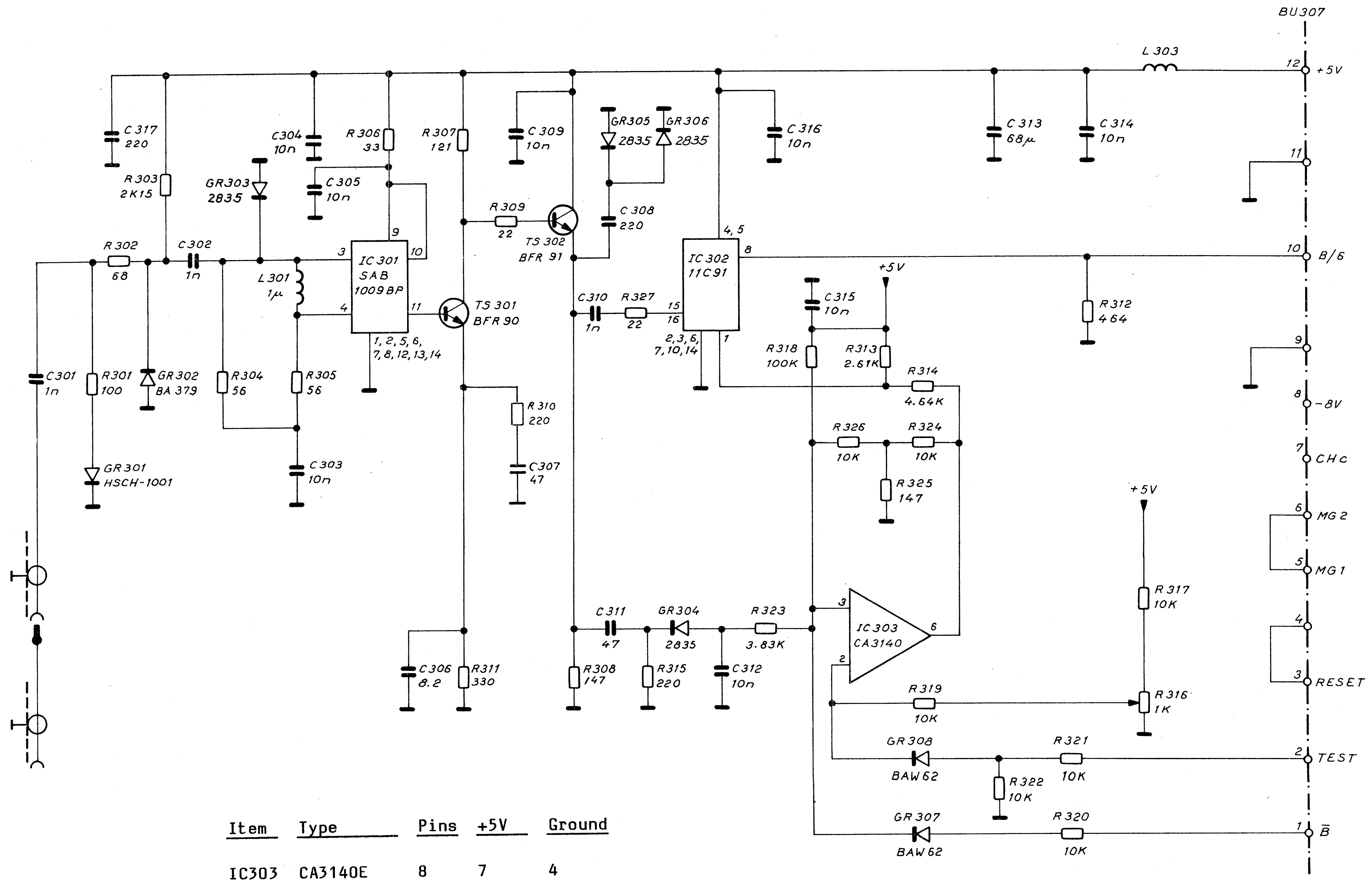
Input amplifier, logic and power supply



Power supply

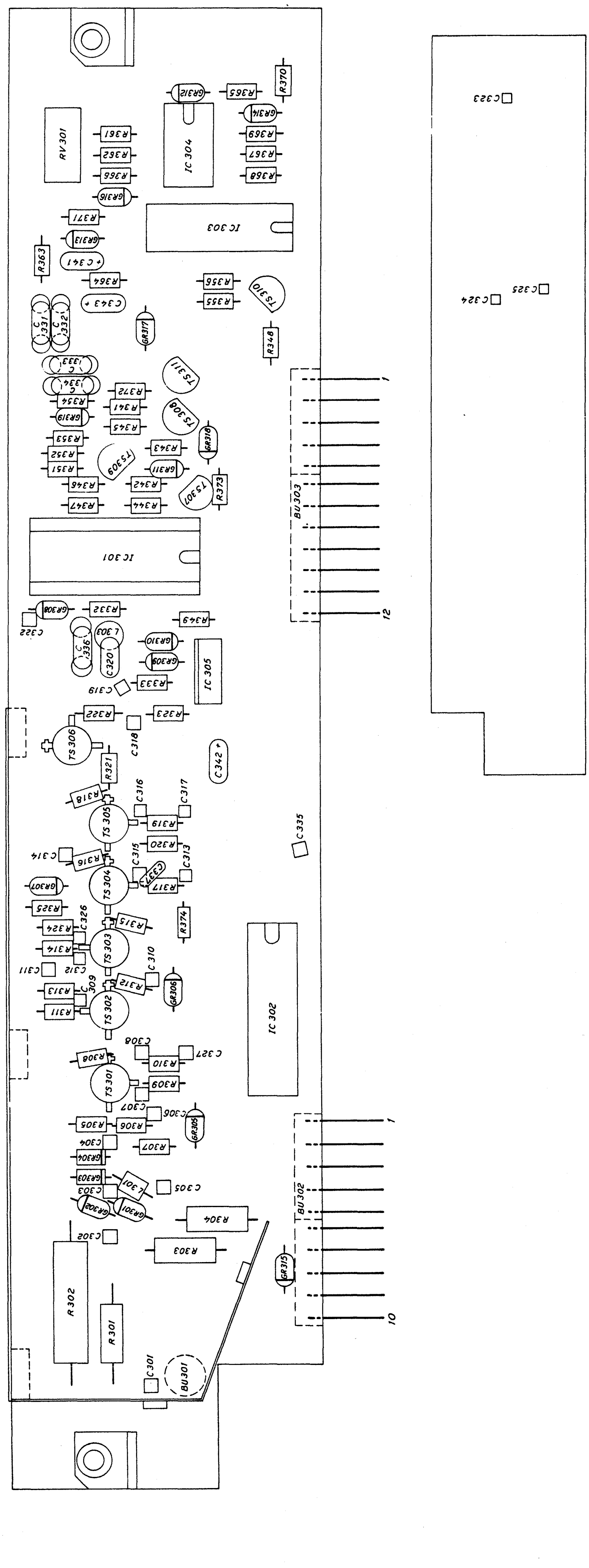


Prescaler PM 6674

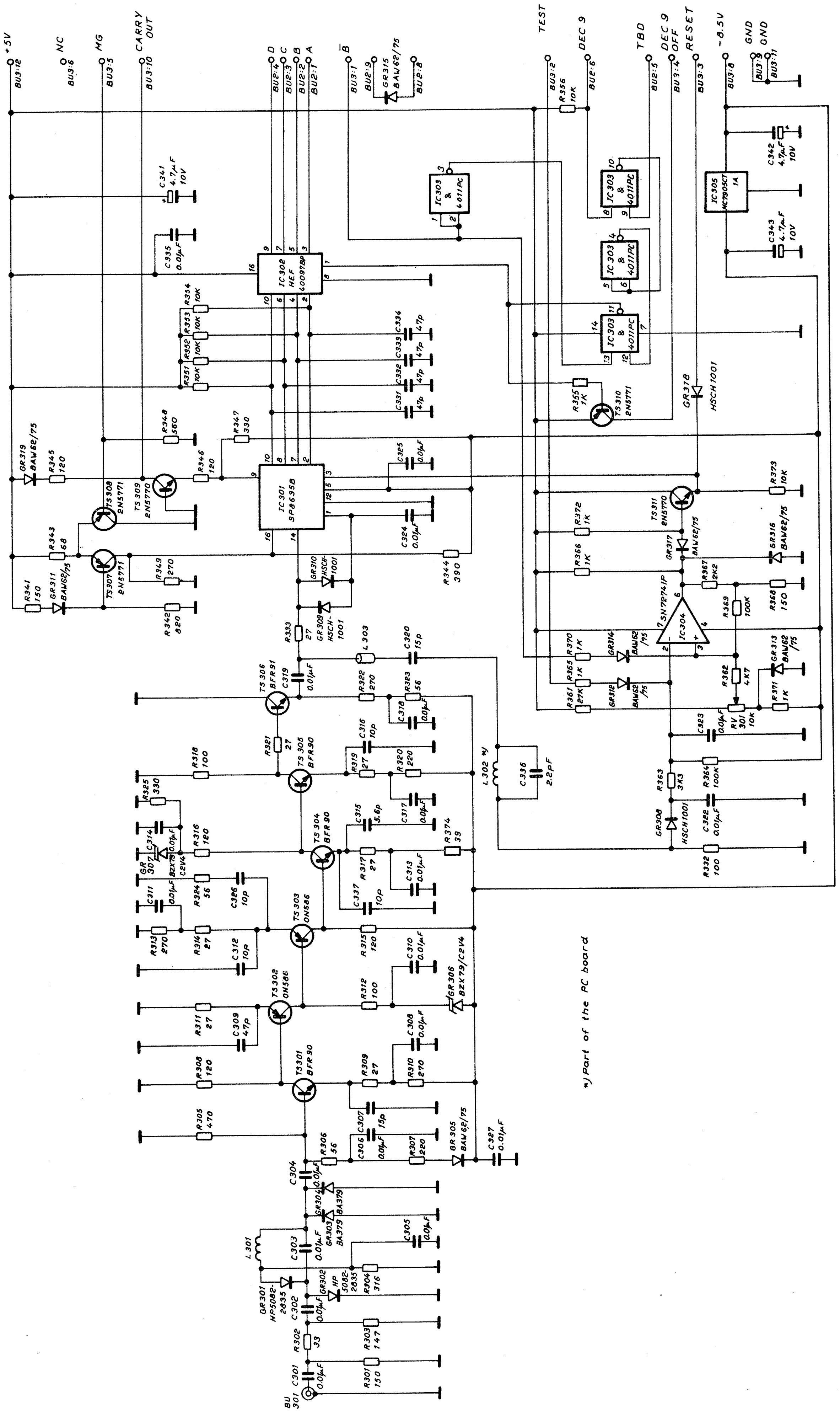


Item	Type	Pins	+5V	Ground
IC303	CA3140E	8	7	4

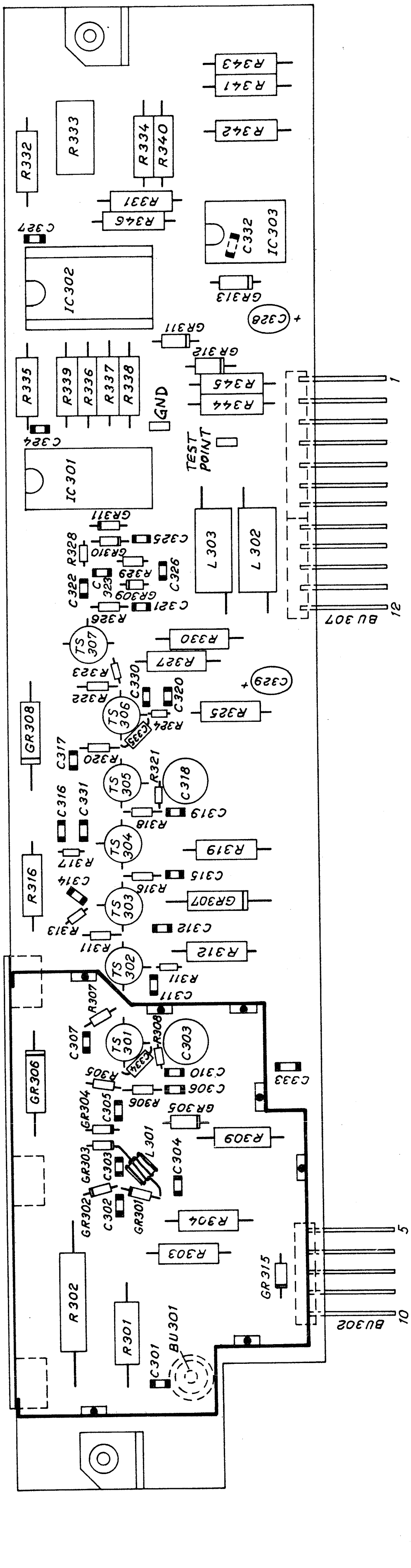
Prescaler PM 6674

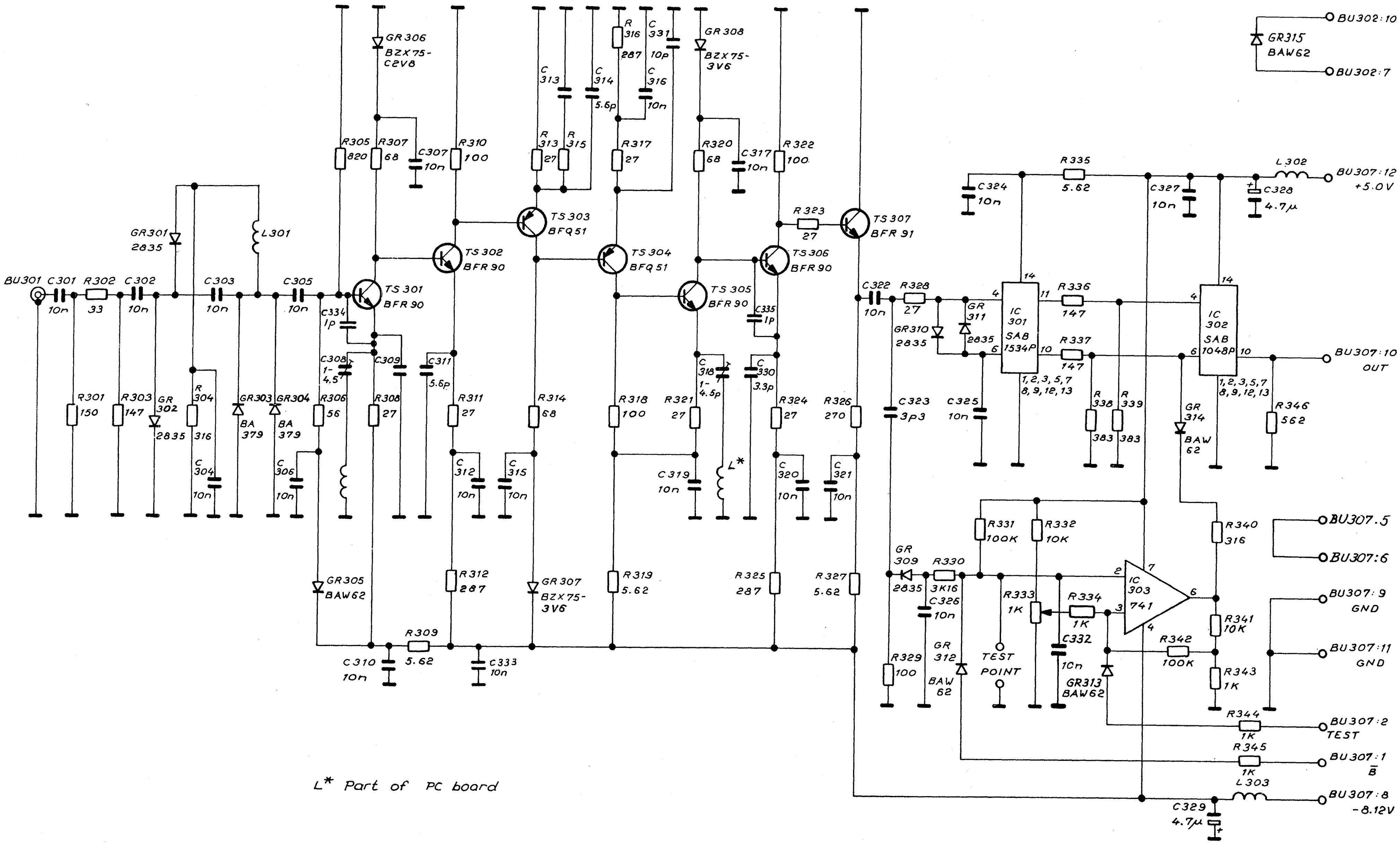


Direct gated input PM 6675



Direct gated input PM 6675


IC301
IC302
IC303
TEST POINT
GND
L302
L303
L301
BU307
BU302
BU301
GR306
GR308
R302
R301



Prescaler PM 6676

Note: In units with a serial number above 1710, a carbon resistor R347 of 150 ohm, 5%, 0.2W has been connected in series with the diode GR309. The order number for the new resistor is 4822 111 30325.

8. SPARE PARTS LIST

- The list is sorted by item number.
- Spare parts for the prescalers can be found at the end of this list.

Order number	Description	Specification			Item
5322 130 90074	Display	7651			B201
5322 130 90074	Display	7651			B202
5322 130 90074	Display	7651			B203
5322 130 90074	Display	7651			B204
5322 130 90074	Display	7651			B205
5322 130 90074	Display	7651			B206
5322 130 90074	Display	7651			B207
5322 130 90074	Display	7651			B208
5322 130 90074	Display	7651			B209
5322 267 10004	Plug, Coax Female				BU1
5322 267 10004	Plug, Coax Female				BU2
5322 267 10004	Plug, Coax Female				BU5
5322 267 10004	Plug, Coax Female				BU6
5322 267 10004	Plug, Coax Female				BU7
5322 268 10147	Battery Input				BU8
5322 265 40181	Connector	13 Pins			BU101
5322 265 64028	Connector	10 Pins			BU103
5322 265 40178	Connector	10 Pins			BU104
5322 265 40181	Connector	4 Pins			BU105
5322 267 50335	Connector	12 Poles			BU107
5322 267 50336	Connector	10 Poles			BU108
5322 265 40181	Connector	6 Pins			BU110
5322 267 34043	PCB connector, Coax				BU120
5322 265 40178	Connector	10 Pins			BU202
5322 267 50334	Connector				BU203
5322 267 30393	Connector				BU204
5322 122 44019	Capacitor, Ceram	1nF	20%	250V	C6
5322 122 44019	Capacitor, Ceram	1nF	20%	250V	C7
4822 124 20673	Capacitor, Foil	470uF		6,3V	C201
4822 121 40036	Capacitor, Foil	100nF	10%	250V	C202
5322 121 44291	Capacitor, Foil	10nF	10%	400V	C1001
4822 122 31188	Capacitor, Ceram	3,3pF	±0,25pF	500V	C1002
4822 122 31349	Capacitor, Ceram	68pF	2%	100V	C1003
4822 122 31414	Capacitor, Ceram	10nF		100V	C1005
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1006
4822 124 20945	Capacitor, Elec.	33uF	40%	10V	C1007
4822 122 31072	Capacitor, Ceram	47pF	2%	100V	C1008
4822 121 41156	Capacitor, Foil	68nF	10%	250V	C1010
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1011
4822 122 31414	Capacitor, Ceram	10nF		100V	C1012
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1013
4822 122 31414	Capacitor, Ceram	10nF		100V	C1014
5322 122 34099	Capacitor, Chip	470pF	20%	50V	C1015
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1016
4822 122 31414	Capacitor, Ceram	10nF		100V	C1017
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1019
4822 122 31414	Capacitor, Ceram	10nF		100V	C1020
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1021
4822 122 31414	Capacitor, Ceram	10nF		100V	C1022
4822 122 31414	Capacitor, Ceram	10nF		100V	C1023
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1024

4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1142
4822 122 31414	Capacitor, Ceram	10nF		100V	C1145
5322 121 40323	Capacitor, Foil	100nF	10%	100V	C1150
4822 122 31414	Capacitor, Ceram	10nF		100V	C1151
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1152
	Capacitor, Ceram	22pF	2%	100V	C1153
5322 125 50051	Capacitor, Trimm	18pF			C1154
5322 121 44291	Capacitor, Foil	10nF	10%	400V	C1156
4822 122 31414	Capacitor, Ceram	10nF		100V	C1157
4822 124 20944	Capacitor, Elec.	1uF	40%	25V	C1158
4822 122 31414	Capacitor, Ceram	10nF		100V	C1160
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1161
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C1162
4822 122 30027	Capacitor, Ceram	1nF	10%	100V	C1163
4822 122 31414	Capacitor, Ceram	10nF		100V	C1164
4822 122 31414	Capacitor, Ceram	10nF		100V	C1165
4822 122 31243	Capacitor, Ceram	82pF	2%	100V	C1170
4822 122 31243	Capacitor, Ceram	82pF	2%	100V	C1171
4822 124 20944	Capacitor, Elec.	1uF	40%	25V	C1172
4822 122 31414	Capacitor, Ceram	10nF		100V	C1173
4822 122 31414	Capacitor, Ceram	10nF		100V	C1174
5322 121 40323	Capacitor, Foil	100nF	10%	100V	C1181
	Capacitor, Elec.	1000uF		40V	C1182
	Capacitor, Elec.	1000uF		40V	C1183
5322 124 14066	Capacitor, Elec.	10uF	50%	6,3V	C1184
	Capacitor, Elec.	470uF	50%	10V	C1185
	Capacitor, Elec.	470uF	50%	10V	C1186
	Capacitor, Elec.	470uF	50%	10V	C1187
4822 124 20945	Capacitor, Elec.	33uF	40%	10V	C1188
4822 122 31414	Capacitor, Ceram	10nF		100V	C1189
4822 122 30114	Capacitor, Ceram	2,2nF	10%	100V	C1190
4822 124 20945	Capacitor, Elec.	33uF	40%	10V	C1191
5322 121 54071	Capacitor, Foil	2,2nF	1%	250V	C1192
	Capacitor, Foil	220nF	20%	63V	C1193
5322 121 40323	Capacitor, Foil	100nF	10%	100V	C1194
5322 263 64007	Jumper				DV1
4822 130 30613	Diode	BAW62			GR101
4822 130 30613	Diode	BAW62			GR102
4822 130 30613	Diode	BAW62			GR103
4822 130 30613	Diode	BAW62			GR104
4822 130 30613	Diode	BAW62			GR106
4822 130 30613	Diode	BAW62			GR135
4822 130 30613	Diode	BAW62			GR136
4822 130 30613	Diode	BAW62			GR137
4822 130 30613	Diode	BAW62			GR138
4822 130 30613	Diode	BAW62			GR139
4822 130 30613	Diode	BAW62			GR140
4822 130 30613	Diode	BAW62			GR141
4822 130 30613	Diode	BAW62			GR142
4822 130 30613	Diode	BAW62			GR145
4822 130 30613	Diode	BAW62			GR146
4822 130 30613	Diode	BAW62			GR147
4822 130 30613	Diode	BAW62			GR148
4822 130 30613	Diode	BAW62			GR150
4822 130 30613	Diode	BAW62			GR151
4822 130 30613	Diode	BAW62			GR152
4822 130 30613	Diode	BAW62			GR153
4822 130 30613	Diode	BAW62			GR154
4822 130 30414	Diode	BY164			GR181
	Diode	BYV27/200			GR182

4822 130 30865	Diode	BYX71/350	GR183
	Diode	BYV27/200	GR184
5322 130 31503	Diode	BZW70-C5V6	GR185
4822 130 34281	Diode	BZX79-B15	GR186
5322 130 31502	LED		GR202
5322 130 31502	LED		GR203
5322 130 31502	LED		GR204
5322 130 31502	LED		GR205
5322 130 31502	LED		GR206
5322 209 86202	Integrated Circuit	SAB1009BP	IC101
5322 209 80956	Integrated Circuit	MC79L05CP	IC102
5322 209 85802	Integrated Circuit	MC10131P	IC140
5322 209 86266	Integrated Circuit	GXB10106P	IC141
5322 209 84643	Integrated Circuit	MC10102L	IC142
5322 209 86441	Integrated Circuit	GXB10116P	IC151
5322 209 84986	Integrated Circuit	SN74LS74N	IC152
5322 209 80958	Integrated Circuit	ICM7555IPA	IC153
5322 209 86203	Integrated Circuit	MC10138P	IC160
5322 209 10164	Integrated Circuit	0Q0040	IC161
5322 209 10166	Integrated Circuit	P8049	IC162
5322 209 14433	Integrated Circuit	HEF40097BP	IC163
4822 209 10051	Integrated Circuit	HEF4076BP	IC164
5322 209 14056	Integrated Circuit	HEF4028BP	IC165
5322 209 85662	Integrated Circuit	TDA1060	IC180
5322 111 94015	Resistor Network	1K x 6 10% 1/8W	IC193
5322 111 94015	Resistor Network	1K x 6 10% 1/8W	IC195
5322 111 90079	Resistor Network	10K x 8 10% 1/8W	IC196
5322 111 90079	Resistor Network	10K x 8 10% 1/8W	IC197
5322 111 90081	Resistor Network	100K x 6 10% 1/8W	IC198
	Integrated Circuit	NE587N (see section Trouble-shooting)	IC201
5322 242 74372	Crystal /01 version	10MHz	KT151
5322 121 44235	Coil		L5
5322 121 44235	Coil		L6
5322 158 10052	Coil		L201
5322 152 20505	Coil, Choke	1uH	L1001
5322 158 10052	Coil	1000uH	L1002
5322 152 20505	Coil, Choke	1uH	L1003
5322 158 10052	Coil		L1181
5322 158 10052	Coil		L1182
5322 462 30207	Potentiometer + Switch	220K Lin.	R1
5322 116 54909	Resistor, M.Film	1K 5% 1,6W	R5
5322 116 50677	Resistor, M.Film	21E5 1% 0,4W	R201
5322 116 54541	Resistor, M.Film	825E 1% 0,4W	R202
5322 116 55257	Resistor, M.Film	953K 1% 0,5W	R1001
5322 116 50557	Resistor, M.Film	46K4 1% 0,4W	R1003
4822 110 72214	Resistor, Carbon	10M 10% 0,33W	R1004
4822 116 51098	Resistor, M.Film	100E 5% 1,6W	R1005
5322 116 50766	Resistor, M.Film	147E 1% 0,4W	R1006
5322 116 54511	Resistor, M.Film	316E 1% 0,4W	R1007
5322 116 54549	Resistor, M.Film	1K 1% 0,4W	R1008
5322 116 54728	Resistor, M.Film	215K 1% 0,4W	R1009
4822 116 51253	Resistor, M.Film	10K 1% 0,4W	R1010
5322 116 54502	Resistor, M.Film	261E 1% 0,4W	R1011
5322 116 50492	Resistor, M.Film	46E4 1% 0,4W	R1012
5322 101 94008	Potentiometer + Switch	500E Log.	R1013
5322 116 50677	Resistor, M.Film	21E5 1% 0,4W	R1014

5322 116 54462	Resistor, M.Film	82E5	1%		0,4W	R1015
5322 116 50492	Resistor, M.Film	46E4	1%		0,4W	R1016
5322 116 54446	Resistor, M.Film	56E2	1%		0,4W	R1019
5322 116 54511	Resistor, M.Film	316E	1%		0,4W	R1020
5322 116 54728	Resistor, M.Film	215K	1%		0,4W	R1021
5322 116 54536	Resistor, M.Film	750E	1%		0,4W	R1022
5322 116 54502	Resistor, M.Film	261E	1%		0,4W	R1023
5322 116 54536	Resistor, M.Film	750E	1%		0,4W	R1024
	Potentiometer, Trim	20K	Cerm	lin.	0,5W	R1025
5322 116 50954	Resistor, M.Film	38E3	1%		0,4W	R1026
4822 116 51233	Resistor, M.Film	681E	1%		0,4W	R1027
5322 116 54426	Resistor, M.Film	121E	1%		0,4W	R1028
4822 116 51253	Resistor, M.Film	10K	1%		0,4W	R1029
5322 116 54541	Resistor, M.Film	825E	1%		0,4W	R1030
5322 116 54632	Resistor, M.Film	14K7	1%		0,4W	R1031
5322 116 54558	Resistor, M.Film	8K25	1%		0,4W	R1032
5322 116 55274	Resistor, M.Film	215E	1%		0,4W	R1033
5322 111 44153	Resistor, Carbon	15E	5%		0,2W	R1034
4822 111 30245	Resistor, Carbon	47E	5%		0,2W	R1035
4822 116 51253	Resistor, M.Film	10K	1%		0,4W	R1036
5322 116 50767	Resistor, M.Film	2K15	1%		0,4W	R1130
4822 116 51253	Resistor, M.Film	10K	1%		0,4W	R1134
4822 116 51253	Resistor, M.Film	10K	1%		0,4W	R1135
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1136
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1137
5322 116 50484	Resistor, M.Film	4K64	1%		0,4W	R1138
5322 116 50536	Resistor, M.Film	464E	1%		0,4W	R1140
5322 116 50536	Resistor, M.Film	464E	1%		0,4W	R1141
5322 116 50536	Resistor, M.Film	464E	1%		0,4W	R1142
5322 116 50484	Resistor, M.Film	4K64	1%		0,4W	R1143
5322 116 50484	Resistor, M.Film	4K64	1%		0,4W	R1144
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1145
4822 116 51253	Resistor, M.Film	10K	1%		0,4W	R1146
5322 116 50767	Resistor, M.Film	2K15	1%		0,4W	R1148
5322 116 54909	Resistor, M.Film	1K	5%		1,6W	R1150
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1151
5322 116 50536	Resistor, M.Film	464E	1%		0,4W	R1152
5322 116 50536	Resistor, M.Film	464E	1%		0,4W	R1153
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1154
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1155
5322 116 54608	Resistor, M.Film	7K5	1%		0,4W	R1156
5322 116 54515	Resistor, M.Film	348E	1%		0,4W	R1157
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1159
5322 116 54518	Resistor, M.Film	383E	1%		0,4W	R1160
5322 116 54518	Resistor, M.Film	383E	1%		0,4W	R1161
5322 116 50484	Resistor, M.Film	4K64	1%		0,4W	R1163
5322 101 14194	Potentiometer, Trim	10K	Cerm	lin.	0,5W	R1164
5322 116 50572	Resistor, M.Film	12K1	1%		0,4W	R1165
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1166
5322 116 50579	Resistor, M.Film	3K16	1%		0,4W	R1167
5322 116 54469	Resistor, M.Film	100E	1%		0,4W	R1168
5322 116 50536	Resistor, M.Film	464E	1%		0,4W	R1169
5322 116 54469	Resistor, M.Film	100E	1%		0,4W	R1170
5322 116 50492	Resistor, M.Film	46E4	1%		0,4W	R1171
5322 116 50492	Resistor, M.Film	46E4	1%		0,4W	R1173
5322 116 54469	Resistor, M.Film	100E	1%		0,4W	R1174
5322 116 55535	Resistor, M.Film	1M	1%		0,4W	R1175
5322 116 54549	Resistor, M.Film	1K	1%		0,4W	R1180
4822 113 60084	Resistor, W.W.	1E	5%		1,0W	R1181
5322 116 60129	Resistor, M.Oxide	0,33E	10%		0,7W	R1182
5322 116 54589	Resistor, M.Film	3K83	1%		0,4W	R1183
4822 116 51233	Resistor, M.Film	681E	1%		0,4W	R1184

5322 116 54469	Resistor, M.Film	100E	1%	0,4W	R1185
5322 116 54446	Resistor, M.Film	56E2	1%	0,4W	R1186
5322 116 50515	Resistor, M.Film	1K78	1%	0,4W	R1187
5322 101 14272	Potentiometer, Trim	5K	Cerm lin.	0,5W	R1188
5322 116 54589	Resistor, M.Film	3K83	1%	0,4W	R1189
5322 116 50451	Resistor, M.Film	21K5	1%	0,4W	R1190
5322 116 54549	Resistor, M.Film	1K	1%	0,4W	R1191
5322 116 54549	Resistor, M.Film	1K	1%	0,4W	R1192
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R1193
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R1194
5322 116 50557	Resistor, M.Film	46K4	1%	0,4W	R1195
5322 116 54657	Resistor, M.Film	31K6	1%	0,4W	R1196
5322 116 50572	Resistor, M.Film	12K1	1%	0,4W	R1197
5322 116 50484	Resistor, M.Film	4K64	1%	0,4W	R1198
5322 116 50557	Resistor, M.Film	46K4	1%	0,4W	R1199
5322 462 30207	Potentiometer + Switch	220K	Lin.		SK1
5322 276 10913	Switch, Pushbut				SK101
5322 276 10913	Switch, Pushbut				SK102
5322 276 10913	Switch, Pushbut				SK103
5322 276 10913	Switch, Pushbut				SK104
5322 276 10913	Switch, Pushbut				SK105
5322 276 10913	Switch, Pushbut				SK106
5322 276 10913	Switch, Pushbut				SK107
5322 276 10913	Switch, Pushbut				SK108
5322 276 10913	Switch, Pushbut				SK109
5322 276 10913	Switch, Pushbut				SK110
5322 276 10913	Switch, Pushbut				SK111
5322 276 10913	Switch, Pushbut				SK112
5322 276 10913	Switch, Pushbut				SK113
5322 276 10911	Switch				SK114
5322 276 10912	Switch				SK115
5322 101 94008	Potentiometer + Switch	500E	Log.		SK116
5322 146 10001	Transformer, Line				T101
5322 146 10002	Transformer, Switch				T102
5322 130 44418	Transistor	BF256A			TS101
5322 130 40379	Transistor	BFW30			TS102
5322 130 44435	Transistor	2N5770			TS103
5322 130 40745	Transistor	BFW92			TS104
5322 130 40745	Transistor	BFW92			TS105
4822 130 44197	Transistor	BC558B			TS130
4822 130 40937	Transistor	BC548B			TS131
4822 130 40937	Transistor	BC548B			TS132
4822 130 40937	Transistor	BC548B			TS133
5322 130 44845	Transistor	2N5771			TS151
5322 130 44845	Transistor	2N5771			TS152
5322 130 44435	Transistor	2N5770			TS153
4822 130 44197	Transistor	BC558B			TS160
4822 130 44256	Transistor	BC557			TS181
5322 130 40753	Transistor	BD132			TS182
4822 130 40855	Transistor	BC337			TS183
4822 130 40937	Transistor	BC548B			TS184
4822 130 44197	Transistor	BC558B			TS186
4822 130 40937	Transistor	BC548B			TS187
5322 130 41682	Transistor	MPS-A12			TS201
5322 130 41682	Transistor	MPS-A12			TS202
5322 130 41682	Transistor	MPS-A12			TS203

5322 130 41682	Transistor	MPS-A12	TS204
5322 130 41682	Transistor	MPS-A12	TS205
5322 130 41682	Transistor	MPS-A12	TS206
5322 130 41682	Transistor	MPS-A12	TS207
5322 130 41682	Transistor	MPS-A12	TS208
5322 130 41682	Transistor	MPS-A12	TS209
4822 130 44197	Transistor	BC558B	TS210
4822 253 20022	Fuse	1,6A Fast 5x20mm	VL102
4822 252 20007	Thermal fuse		VL101

MISCELLANEOUS

Order number	Description	Specification
5322 265 30066	Line Input	
5322 272 10217	Line Voltage Selector	
5322 256 34104	Fuse holder for V1102	
5322 268 20097	Socket, for IC301 PM6676	
5322 255 40233	Socket, IC	40 Poles
5322 255 40234	Socket, IC	28 Poles
5322 255 40235	Socket, IC	18 Poles
5322 255 40236	Socket, IC	16 Poles
5322 255 40237	Socket, IC	14 Poles
5322 267 34043	PCB connector, Coax	
5322 321 20504	Coax cable+Connector to U3	
5322 321 20505	Coax Cable+Connector to U1	

CABINET

Order number	Description	Specification
5322 414 34091	Knob for potentiometer	
5322 414 74015	Cap for potentiometer knob	
5322 414 25851	Button, Push	Green/Grey
5322 414 26019	Button, Push	Light Grey
5322 447 90006	Cover, Top	
5322 447 90007	Cover, Bottom	
5322 462 44179	Bottom foot	
5322 462 44431	Plug in bottom foot	
5322 462 44181	Rear foot	
5322 466 85335	Front rim	
5322 459 24054	Rear rim	
5322 498 50127	Handle	
5322 528 34101	Lock washer in handle	
5322 520 34164	Bearing bush to the handle	
5322 414 64053	Knob to the handle	
5322 530 84075	Spring to the handle	
5322 535 94637	Extention Bar for SK101	
5322 492 64337	Clip to Extention Bar	
5322 466 60835	Cabinet side profile	
5322 477 90011	Cover, rear panel slot	
5322 462 34127	Guide rail for U1	
5322 456 10004	Text plate PM6673	
5322 456 10005	Text Plate PM6674	
5322 456 10006	Text plate PM6676	
5322 447 84642	Front cover	

PM 6674, UNIT 3

Order number	Description	Specification			Item
5322 265 40182	Connector	7 Pins			BU302
5322 265 40182	Connector	7 Pins			BU307
4822 122 31175	Capacitor, Ceram	1nF	10%	500V	C301
4822 122 30027	Capacitor, Ceram	1nF	10%	100V	C302
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C303
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C304
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C305
	Capacitor, Ceram	8,2pF	±0,25pF	100V	C306
4822 122 31072	Capacitor, Ceram	47pF	2%	100V	C307
4822 122 30094	Capacitor, Ceram	220pF	10%	100V	C308
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C309
4822 122 30027	Capacitor, Ceram	1nF	10%	100V	C310
4822 122 31072	Capacitor, Ceram	47pF	2%	100V	C311
4822 122 31414	Capacitor, Ceram	10nF		100V	C312
4822 124 20941	Capacitor, Elec.	68uF	40%	6,3V	C313
4822 122 31414	Capacitor, Ceram	10nF		100V	C314
4822 122 31414	Capacitor, Ceram	10nF		100V	C315
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C316
4822 122 30094	Capacitor, Ceram	220pF	10%	100V	C317
5322 130 34877	Diode	HSCH1001			GR301
5322 130 34364	Diode	BAW379			GR302
5322 130 34283	Diode	HP5082-2835			GR303
5322 130 34283	Diode	HP5082-2835			GR304
5322 130 34283	Diode	HP5082-2835			GR305
5322 130 34283	Diode	HP5082-2835			GR306
4822 130 30613	Diode	BAW62			GR307
4822 130 30613	Diode	BAW62			GR308
5322 209 86202	Integrated Circuit	SAB1009BP			IC301
5322 209 80957	Integrated Circuit	11C91DC			IC302
5322 209 86201	Integrated Circuit	CA3140E			IC303
5322 158 10311	Coil				L301
5322 158 10052	Coil				L303
5322 116 54392	Resistor, M.Film	100E	5%	2,5W	R301
5322 116 54396	Resistor, M.Film	68E	5%	2,5W	R302
5322 116 50767	Resistor, M.Film	2K15	1%	0,4W	R303
5322 111 30074	Resistor, Carbon	56E	5%	0,2W	R304
5322 111 30074	Resistor, Carbon	56E	5%	0,2W	R305
4822 111 30067	Resistor, Carbon	33E	5%	0,2W	R306
5322 116 54426	Resistor, M.Film	121E	1%	0,4W	R307
5322 116 50766	Resistor, M.Film	147E	1%	0,4W	R308
5322 111 30396	Resistor, Carbon	22E	5%	0,2W	R309
4822 111 30327	Resistor, Carbon	220E	5%	0,2W	R310
4822 111 30328	Resistor, Carbon	330E	5%	0,2W	R311
5322 116 50536	Resistor, M.Film	464E	1%	0,4W	R312
5322 116 50671	Resistor, M.Film	2K61	1%	0,4W	R313
5322 116 50484	Resistor, M.Film	4K64	1%	0,4W	R314
4822 111 30327	Resistor, Carbon	220E	5%	0,2W	R315

5322 101 14299	Potentiometer, Trim	1K			R316
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R317
4822 116 51268	Resistor, M.Film	100K	1%	0,4W	R318
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R319
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R320
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R321
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R322
5322 116 54589	Resistor, M.Film	3K83	1%	0,4W	R323
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R324
5322 116 50766	Resistor, M.Film	147E	1%	0,4W	R325
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R326
5322 111 30396	Resistor, Carbon	22E	5%	0,2W	R327
5322 130 44179	Transistor	BFR90			TS301
5322 130 44181	Transistor	BFR91			TS302

PM 6675, UNIT 3

Order number	Description	Specification			Item
5322 267 34043	Plug, Coax, Female				BU301
5322 122 34098	Capacitor	10nF	20%	50V	C301
5322 122 34098	Capacitor	10nF	20%	50V	C302
5322 122 34098	Capacitor	10nF	20%	50V	C303
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C304
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C305
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C306
5322 122 34097	Capacitor	15pF	10%	50V	C307
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C308
5322 122 34043	Capacitor	47pF	10%	50V	C309
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C310
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C311
5322 122 34046	Capacitor	10pF	10%	50V	C312
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C313
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C314
5322 122 34096	Capacitor	5.6pF	10%	50V	C315
5322 122 34046	Capacitor	10pF	10%	50V	C316
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C317
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C318
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C319
	Capacitor	15pF	2%	100V	C320
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C322
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C323
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C324
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C325
5322 122 34046	Capacitor	10pF	10%	50V	C326
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C327
4822 122 31072	Capacitor	47pF	2%	100V	C331
4822 122 31072	Capacitor	47pF	2%	100V	C332
4822 122 31072	Capacitor	47pF	2%	100V	C333
4822 122 31072	Capacitor	47pF	2%	100V	C334
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C335
	Capacitor	2.2pF	±0.25pF	100V	C336
	Capacitor	10pF	2%	100V	C337
	Capacitor	4.7uF	±20%	10V	C341
	Capacitor	4.7uF	±20%	10V	C342
	Capacitor	4.7uF	±20%	10V	C343

5322 130 34283	Diode	HP5082-2835			GR301
5322 130 34283	Diode	HP5082-2835			GR302
5322 130 34364	Diode	BAW379			GR303
5322 130 34364	Diode	BAW379			GR304
4822 130 30613	Diode	BAW62			GR305
4822 130 31253	Diode	BZX79/C2V4			GR306
4822 130 31253	Diode	BZX79/C2V4			GR307
5322 130 34877	Diode	HSCH1001			GR308
5322 130 34877	Diode	HSCH1001			GR309
5322 130 34877	Diode	HSCH1001			GR310
4822 130 30613	Diode	BAW62			GR311
4822 130 30613	Diode	BAW62			GR312
4822 130 30613	Diode	BAW62			GR313
4822 130 30613	Diode	BAW62			GR314
4822 130 30613	Diode	BAW62			GR315
4822 130 30613	Diode	BAW62			GR316
4822 130 30613	Diode	BAW62			GR317
5322 130 34877	Diode	HSCH1001			GR318
4822 130 30613	Diode	BAW62			GR319
5322 209 85204	Integrated circuit	SP8635B			IC301
5322 209 14433	Integrated circuit	HEF40097BP			IC302
	Integrated circuit	4011PC			IC303
5322 209 85254	Integrated circuit	UA741CN			IC304
5322 209 85456	Integrated circuit	MC7905CT			IC305
4822 526 10025	FXC-tube	4B			L303
4822 116 51142	Resistor, M.Film	150E	5%	1,6W	R301
4822 116 51087	Resistor, M.Film	33E	5%	2,5W	R302
5322 116 50766	Resistor, M.Film	147E	1%	0.4W	R303
5322 116 54511	Resistor, M.Film	316E	1%	0,4W	R304
4822 111 30331	Resistor, Carbon	470E	5%	0.2W	R305
5322 111 30074	Resistor, Carbon	56E	5%	0,2W	R306
4822 111 30327	Resistor, Carbon	220E	5%	0,2W	R307
5322 111 30298	Resistor, Carbon	120E	5%	0.2W	R308
4822 111 30348	Resistor, Carbon	27E	5%	0.2W	R309
4822 111 30323	Resistor, Carbon	270E	5%	0.2W	R310
4822 111 30348	Resistor, Carbon	27E	5%	0.2W	R311
4822 111 30324	Resistor, Carbon	100E	5%	0.2W	R312
4822 111 30323	Resistor, Carbon	270E	5%	0.2W	R313
4822 111 30348	Resistor, Carbon	27E	5%	0.2W	R314
5322 111 30298	Resistor, Carbon	120E	5%	0.2W	R315
5322 111 30298	Resistor, Carbon	120E	5%	0.2W	R316
4822 111 30348	Resistor, Carbon	27E	5%	0.2W	R317
4822 111 30324	Resistor, Carbon	100E	5%	0.2W	R318
4822 111 30348	Resistor, Carbon	27E	5%	0.2W	R319
4822 111 30327	Resistor, Carbon	220E	5%	0,2W	R320
4822 111 30348	Resistor, Carbon	27.E	5%	0.2W	R321
4822 111 30323	Resistor, Carbon	270E	5%	0.2W	R322
5322 111 30074	Resistor, Carbon	56E	5%	0.2W	R323
5322 111 30074	Resistor, Carbon	56E	5%	0.2W	R324
4822 111 30328	Resistor, Carbon	330E	5%	0.2W	R325
4822 111 30324	Resistor, Carbon	100E	5%	0.2W	R332
4822 111 30348	Resistor, Carbon	27E	5%	0.2W	R333
4822 111 30325	Resistor, Carbon	150E	5%	0,2W	R341
4822 111 30271	Resistor, Carbon	820E	5%	0,2W	R342
5322 111 30383	Resistor, Carbon	68E	5%	0.2W	R343
4822 111 30329	Resistor, Carbon	390E	5%	0.2W	R344

5322 111 30298	Resistor, Carbon	120E	5%	0.2W	R345
5322 111 30298	Resistor, Carbon	120E	5%	0.2W	R346
4822 111 30328	Resistor, Carbon	330E	5%	0.2W	R347
4822 111 30309	Resistor, Carbon	560E	5%	0.2W	R348
4822 111 30323	Resistor, Carbon	270E	5%	0.2W	R349
4822 111 30273	Resistor, Carbon	10.K	5%	0.2W	R351
4822 111 30273	Resistor, Carbon	10K	5%	0.2W	R352
4822 111 30273	Resistor, Carbon	10K	5%	0.2W	R353
4822 111 30273	Resistor, Carbon	10K	5%	0.2W	R354
4822 111 30269	Resistor, Carbon	1K	5%	0.2W	R355
4822 111 30273	Resistor, Carbon	10K	5%	0.2W	R356
5322 111 30278	Resistor, Carbon	27K	5%	0.2W	R361
4822 111 30312	Resistor, Carbon	4.7K	5%	0.2W	R362
4822 111 30263	Resistor, Carbon	3.3K	5%	0.2W	R363
4822 111 30296	Resistor, Carbon	100K	5%	0.2W	R364
4822 111 30269	Resistor, Carbon	1K	5%	0.2W	R365
4822 111 30269	Resistor, Carbon	1K	5%	0.2W	R366
4822 111 30265	Resistor, Carbon	2.2K	5%	0.2W	R367
4822 111 30325	Resistor, Carbon	150E	5%	0.2W	R368
4822 111 30296	Resistor, Carbon	100K	5%	0.2W	R369
4822 111 30269	Resistor, Carbon	1K	5%	0.2W	R370
4822 111 30269	Resistor, Carbon	1K	5%	0.2W	R371
4822 111 30269	Resistor, Carbon	1K	5%	0.2W	R372
4822 111 30273	Resistor, Carbon	10K	5%	0.2W	R373
4822 111 30069	Resistor, Carbon	39E	5%	0.2W	R374
5322 101 14254	Potentiometer	10K	10%		RV301
5322 130 44179	Transistor	BFR90			TS301
5322 130 41683	Transistor	ON586 = BFQ51			TS302
5322 130 41683	Transistor	ON586 = BFQ51			TS303
5322 130 44179	Transistor	BFR90			TS304
5322 130 44179	Transistor	BFR90			TS305
5322 130 44181	Transistor	BFR91			TS306
5322 130 44845	Transistor	2N5771			TS307
5322 130 44845	Transistor	2N5771			TS308
5322 130 44435	Transistor	2N5770			TS309
5322 130 44845	Transistor	2N5771			TS310
5322 130 44435	Transistor	2N5770			TS311

PM 6676, UNIT 3

Order number	Description	Specification			Item
5322 267 34043	Plug, Coax, Female				BU301
5322 265 40182	Connector	7 Pins			BU302
5322 265 40182	Connector	7 Pins			BU307
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C301
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C302
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C303
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C304
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C305
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C306
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C307
5322 125 54055	Capacitor, Trimmer	4,5pF			C308

5322 122 34098	Capacitor, Chip	10nF	20%	50V	C310
5322 122 34096	Capacitor, Chip	5,6pF	10%	50V	C311
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C312
5322 122 34096	Capacitor, Chip	5,6pF	10%	50V	C314
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C315
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C316
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C317
5322 125 54055	Capacitor, Trimmer	4,5pF			C318
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C319
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C320
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C321
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C322
5322 122 31594	Capacitor, Ceram	3,3pF	10%	50V	C323
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C324
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C325
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C326
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C327
5322 124 14064	Capacitor, Elec.	4,7uF	20%	25V	C328
5322 124 14064	Capacitor, Elec.	4,7uF	20%	25V	C329
5322 122 31594	Capacitor, Ceram	3,3pF	10%	50V	C330
5322 122 34046	Capacitor, Chip	10pF	10%	50V	C331
5322 122 34098	Capacitor, Chip	10nF	20%	50V	C332
	Capacitor	1nF	20%	50V	C333
	Capacitor	1pF	±0,25pF	100V	C334
	Capacitor	1pF	±0,25pF	100V	C335
5322 130 34283	Diode	HP5082-2835			GR301
5322 130 34283	Diode	HP5082-2835			GR302
5322 130 34364	Diode	BAW379			GR303
5322 130 34364	Diode	BAW379			GR304
4822 130 30613	Diode	BAW62			GR305
4822 130 34048	Diode	BZX75-C2V8			GR306
4822 130 30765	Diode	BZX75-C3V6			GR307
4822 130 30765	Diode	BZX75-C3V6			GR308
5322 130 34283	Diode	HP5082-2835			GR309
5322 130 34283	Diode	HP5082-2835			GR310
5322 130 34283	Diode	HP5082-2835			GR311
4822 130 30613	Diode	BAW62			GR312
4822 130 30613	Diode	BAW62			GR313
4822 130 30613	Diode	BAW62			GR314
4822 130 30613	Diode	BAW62			GR315
5322 209 86264	Integrated Circuit	SAB1534P			IC301
5322 209 86263	Integrated Circuit	SAB1048			IC302
5322 209 85254	Integrated Circuit	uA741CN			IC303
5322 158 14119	Coil				L301
5322 158 10052	Coil				L302
5322 158 10052	Coil				L303
4822 116 51142	Resistor, M.Film	150E	5%	1,6W	R301
4822 116 51087	Resistor, M.Film	33E	5%	2,5W	R302
5322 116 50766	Resistor, M.Film	147E	1%	0,4W	R303
5322 116 54511	Resistor, M.Film	316E	1%	0,4W	R304
4822 111 30271	Resistor, Carbon	820E	5%	0,2W	R305
5322 111 30074	Resistor, Carbon	56E	5%	0,2W	R306
5322 111 30383	Resistor, Carbon	68E	5%	0,2W	R307

5322 111 90078	Resistor, Chip	27E	5%	0,15W	R308
5322 116 54128	Resistor, M.Film	5E62	1%	0,4W	R309
4822 111 30324	Resistor, Carbon	100E	5%	0,2W	R310
5322 111 90078	Resistor, Chip	27E	5%	0,15W	R311
5322 116 54506	Resistor, M.Film	287E	1%	0,4W	R312
5322 111 90078	Resistor, Chip	27E	5%	0,15W	R313
5322 111 30383	Resistor, Carbon	68E	5%	0,2W	R314
5322 116 54506	Resistor, M.Film	287E	1%	0,4W	R316
5322 111 90078	Resistor, Chip	27E	5%	0,15W	R317
4822 111 30324	Resistor, Carbon	100E	5%	0,2W	R318
5322 116 54128	Resistor, M.Film	5E62	1%	0,4W	R319
5322 111 30383	Resistor, Carbon	68E	5%	0,2W	R320
5322 111 90078	Resistor, Chip	27E	5%	0,15W	R321
4822 111 30324	Resistor, Carbon	100E	5%	0,2W	R322
5322 111 90078	Resistor, Chip	27E	5%	0,15W	R323
5322 111 90078	Resistor, Chip	27E	5%	0,15W	R324
5322 116 54506	Resistor, M.Film	287E	1%	0,4W	R325
4822 111 30323	Resistor, Carbon	270E	5%	0,2W	R226
5322 116 54128	Resistor, M.Film	5E62	1%	0,4W	R327
5322 111 90078	Resistor, Chip	27E	5%	0,15W	R328
4822 111 30324	Resistor, Carbon	100E	5%	0,2W	R329
5322 116 50579	Resistor, M.Film	3K16	1%	0,4W	R330
4822 116 51268	Resistor, M.Film	100K	1%	0,4W	R331
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R332
5322 101 14299	Potentiometer, Trim	1K			R333
5322 116 54549	Resistor, M.Film	1K	1%	0,4W	R334
5322 116 54128	Resistor, M.Film	5E62	1%	0,4W	R335
5322 116 50766	Resistor, M.Film	147E	1%	0,4W	R336
5322 116 50766	Resistor, M.Film	147E	1%	0,4W	R337
5322 116 54518	Resistor, M.Film	383E	1%	0,4W	R338
5322 116 54518	Resistor, M.Film	383E	1%	0,4W	R339
5322 116 54511	Resistor, M.Film	316E	1%	0,4W	R340
4822 116 51253	Resistor, M.Film	10K	1%	0,4W	R341
4822 116 51268	Resistor, M.Film	100K	1%	0,4W	R342
5322 116 54549	Resistor, M.Film	1K	1%	0,4W	R343
5322 116 54549	Resistor, M.Film	1K	1%	0,4W	R344
5322 116 54549	Resistor, M.Film	1K	1%	0,4W	R345
5322 116 54009	Resistor, M.Film	562E	1%	0,4W	R346

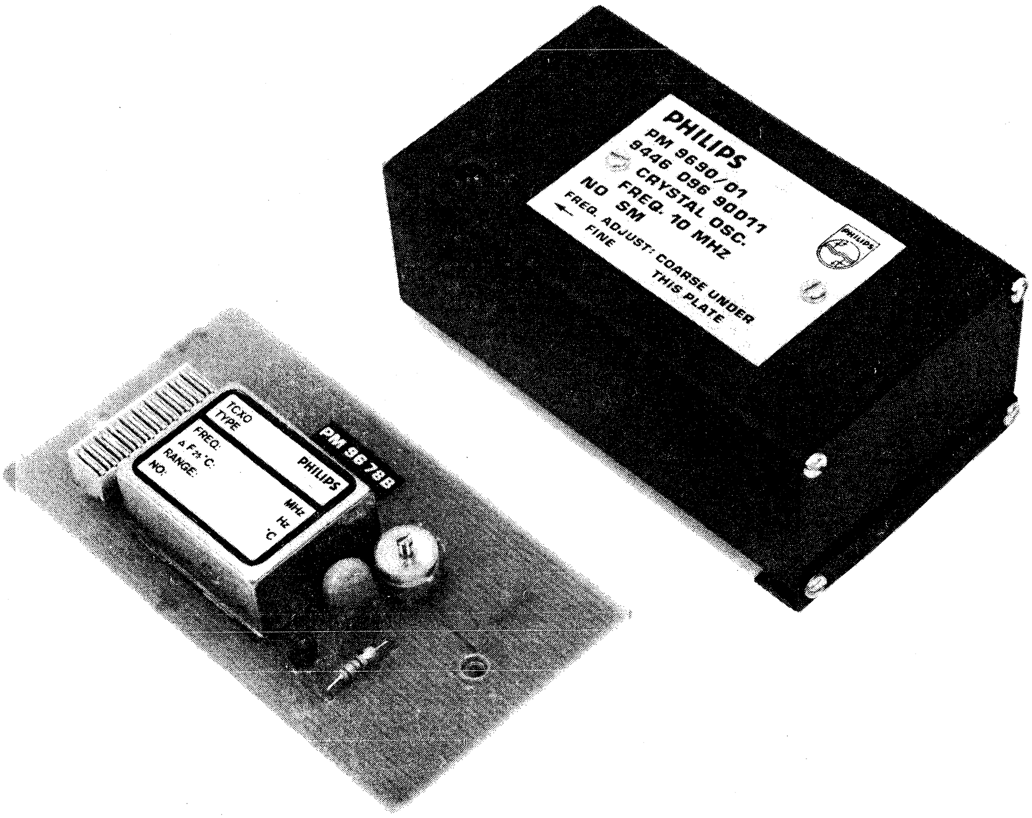
5322 130 44179	Transistor	BFR90	TS301
5322 130 44179	Transistor	BFR90	TS302
5322 130 41683	Transistor	ON586 = BFQ51	TS303
5322 130 41683	Transistor	ON586 = BFQ51	TS304
5322 130 44179	Transistor	BFR90	TS305
5322 130 44179	Transistor	BFR90	TS306
5322 130 44181	Transistor	BFR91	TS307

OPTIONAL OSCILLATORS

PM 9678B
PM 9679E
PM 9690
PM 9691

Instruction Manual

820615



9. OPTIONAL OSCILLATORS

Technical specification

	02 version PM 9678B	03 version PM 9679E	04 version PM 9690	05 version PM 9691
Nominal frequency	10MHz	10MHz	10MHz	10MHz
Trimming range (1	>±20Hz	-100...+40Hz	-7...+3Hz	-7...+3Hz
Output voltage into 1 kohm	$>100mV_{RMS}$	$>1V_{RMS}$	$>150mV_{RMS}$	$>150mV_{RMS}$
Supply voltage, DC	+11.5...28V	+11.5...28V	+11.5...28V	+11.5...28V
Power consumption (+23°C)				
- Continuous operation	< 15mA (2	< 100mA (3	< 125mA (2	< 125mA (2
- Stand-by	none	< 100mA (3	< 125mA (2	< 125mA (2
- Warm-up	none	< 400mA	< 400mA	< 400mA
Stability against:				
- Ageing /24h	NA	NA	$<1.5\times10^{-9}$ (4	$<5\times10^{-10}$ (4
/month	$<1\times10^{-7}$	$<1\times10^{-7}$	$<3\times10^{-8}$	$<1\times10^{-8}$
/year	$<5\times10^{-7}$	$<5\times10^{-7}$	$<1.5\times10^{-7}$	$<7.5\times10^{-8}$
- Temperature 0...50°C ref. to 23°C	$<1\times10^{-6}$	$<1\times10^{-7}$	$<3\times10^{-8}$	$<5\times10^{-9}$
- Line voltage ±10%	$<1\times10^{-9}$	$<1\times10^{-9}$	$<5\times10^{-10}$	$<5\times10^{-10}$
- Change of measuring mode and change between line and ext/int battery	$<5\times10^{-8}$	$<1\times10^{-8}$	$<3\times10^{-9}$	$<3\times19^{-9}$
Warm-up time to reach 1×10^{-7}	NA	<10 min	<15 min	<15 min
Dimensions	93x50x15mm	100x52x35mm	100x52x35mm	100x52x35mm
Weight	25g	100g	100g	100g

Environmental conditions: All oscillators meet the same specifications as the PM 6670 series of counters.

(1 The trimming range will cover at least 10 years of operation since the ageing will decrease substantially after the first 6 months. For PM 9690 and PM 9691 the indicated values apply only to the fine trimming range. However, a coarse trimmer is available.

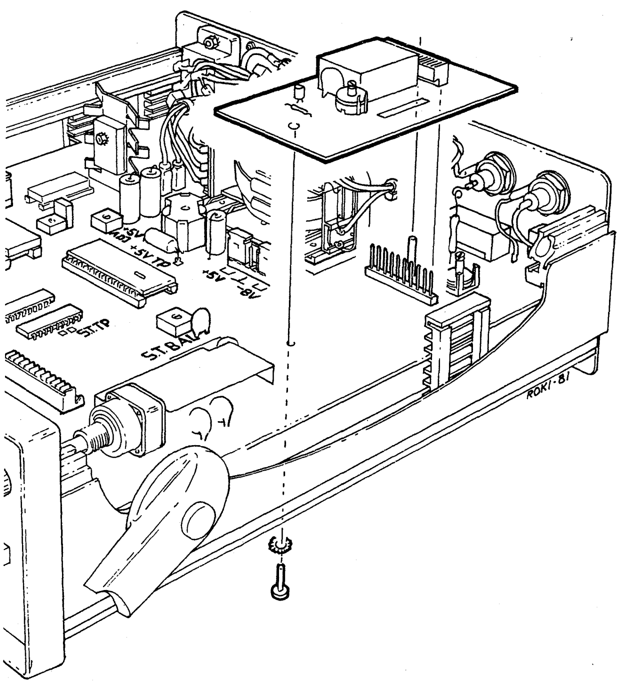
(2 At 11.5...28V

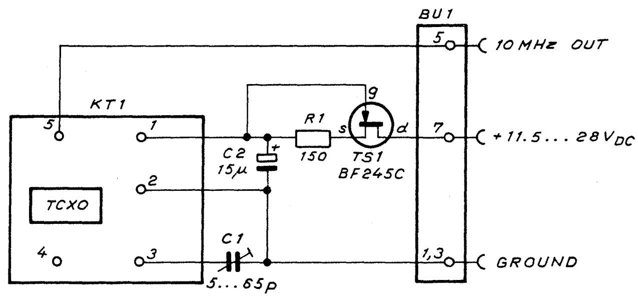
(3 At 11.5V. Less than 60mA at 28V

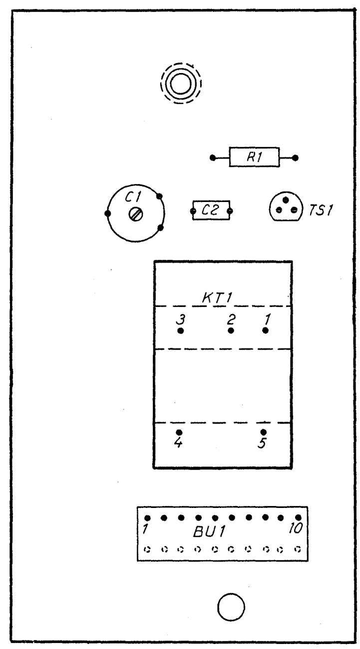
(4 After 48 hours of continuous operation.

Installation of PM 9678B

Remove the x-tal KT151 before installing the oscillator PM 9678B.







Frequency adjustment of PM 9678B

This adjustment requires a reference oscillator with an accuracy of $< 1 \times 10^{-7}$. Philips oven enclosed oscillators PM 9680, PM 9681, PM 9690 and PM 9691 meet this requirement, if calibrated. The adjustment should preferably be made at an ambient temperature of +23°C.

- Connect the reference signal to Input A of the counter to be adjusted.
- Set the measuring time to 1s and press the ⊓⊔ pushbutton.
- Adjust trimming capacitor C1 on the oscillator board until the display read-out is:

  10000.000kHz ± 1Hz.
- Set the measuring time to 10s and check that the display read-out is the same as before. If not, adjust C1 slightly to obtain the correct read-out.

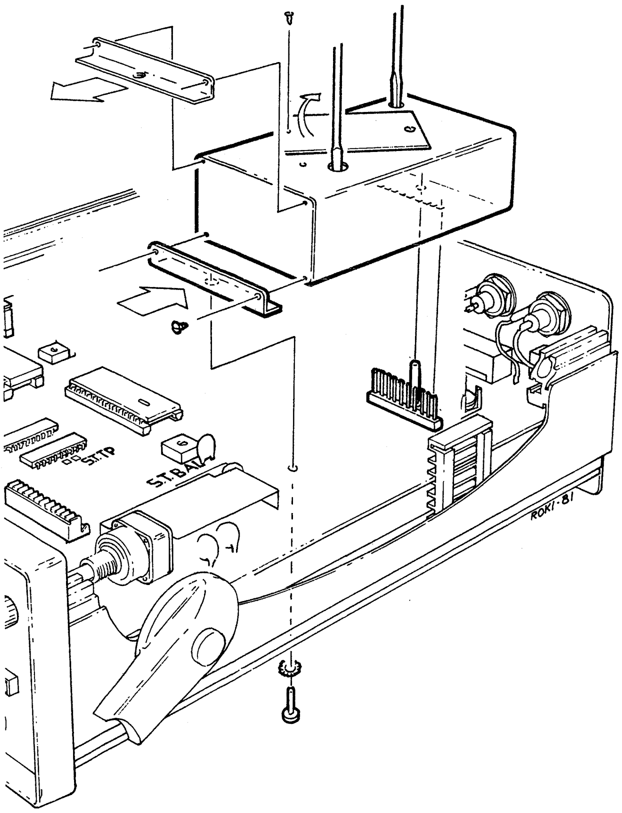
Spare parts list

Order number	Description	Specification	Item
5322 267 50336	Connector	10 poles	BU1
4822 125 50017	Cap, Trim.	5.5-65pF 100V	C1
4822 124 20977	Cap, Elec.	15uF 16V	C2
5322 216 94047	Osc, TCXO	10MHz	KT1
4822 110 63085	Res, Carbon	150E 5% 0.33W	R1
4822 130 41065	Trans, FET	BF245C	TS1

Installation of PM 9679E, PM 9690 and PM 9691

Remove the x-tal KT151 before installing the optional oscillator. Only the bracket with the rivet nut should be mounted on the oscillator.

Note: Before installing an older version of these oven enclosed oscillators, measure if pole 1 and 2 of the oscillator are short circuit. If so, cut pin 1 and 2 on BU103 in the counter.



Frequency adjustment of PM 9679E

This adjustment requires a reference oscillator with an accuracy of $<3\times10^{-8}$. Philips oven enclosed oscillators PM 9680, PM 9681, PM 9690 and PM 9691 meet this requirement, if calibrated. The adjustment should preferably be made at an ambient temperature of 23°C and the oscillator must have been operating continuously for 48 hours before any adjustment is made. An isolated trimming screw driver is also neccessary.

- Connect the reference signal to EXT TRIGG of a 50MHz oscilloscope, e.g. Philips PM 3215.
- Connect the oscillator signal available at socket INT STD OUT of the counter to be adjusted, to Input Y of the oscilloscope.
- Set the oscilloscope to 100ns/div and adjust the trimmer until the waveform moves with a velocity of max 1div/3s (0.3Hz).

Frequency adjustment of PM 9690 and PM 9691

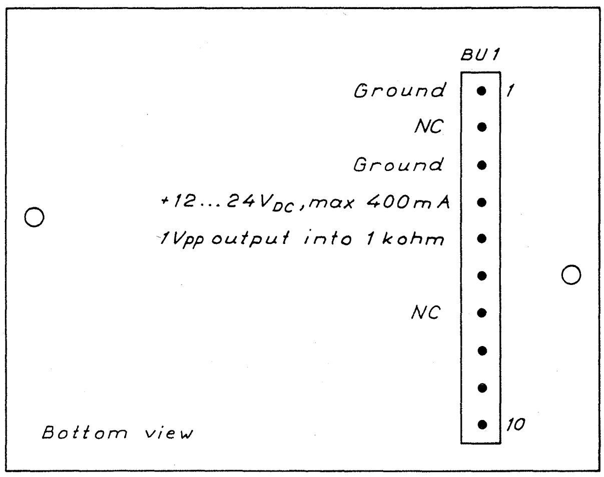
This adjustment requires a reference oscillator with an accuracy of $<1\times10^{-9}$. Hewlett-Packard quartz frequency standard HP105 meets this requirement, if calibrated. The adjustment should preferably be made at an ambient temperature of 23°C and the oscillator must have been operating continuously for 48 hours before any adjustment is made. An isolated trimming screw driver is also neccessary.

- Connect any of the three reference signals available at sockets 5MHz, 1MHz and 100kHz of the HP105 to EXT TRIGG of a 50MHz oscilloscope, e.g. Philips PM 3215.
- Connect the oscillator signal available at socket INT STD OUT of the counter to be adjusted, to Input Y of the oscilloscope.
- Set the oscilloscope to 100ns/div and adjust the fine trimmer in the oscillator until the waveform moves with a velocity of max 1div/10s (0.1Hz).

If the adjustment range is too narrow, proceed as follows:

- Set the fine trimmer fully clockwise.
- Remove the two screws fixing the oscillator's text plate to the unit.
- Remove the small plastic cylinder beneath the text plate using a pair of tweezers.
- Connect an external counter via a 10Mohm probe to socket INT STD OUT of the counter to be adjusted.
- Adjust the coarse trimmer until the display read-out of the external counter is:
  10000003Hz.
- Refit the plastic cylinder and the text plate.
- Recheck that the waveform velocity is 1div/10s, see above.

Pinning of PM 9679E, PM 9690 and PM 9691



Note: Pin 6, 8, 9 and 10 are for factory use only

Repair of oscillator PM 9679E, PM 9690 and PM 9691

Repair of these oscillators may not be carried out by the local service organization. The complete sealed oscillator unit has to be sent to the factory for repair.

Factory address:

PHILIPS Elektronikindustrier AB
Industrial Operations
Supply Centre Service Department
S-175 88 JÄRFÄLLA
Sweden

Sales and service all over the world

Alger: Bureau de Liaison Philips,
24 bis Rue Bougainville,
El Mouradia, Alger; tel.: 565672

Argentina: Philips Argentina S.A.,
Cassila de Correo 3479, (Central), 1430 Buenos Aires;
tel. (1)70-12421/70-2325/2905/6488

Australia: Philips Scientific & Industrial
Equipment Division, Centre Court,
25 - 27 Paul Street, P.O. Box 119,
North Ryde/NSW 2113; tel. (2)888-8222

Bangla Desh: Philips Bangla Desh Ltd.,
P.O. Box 62; Ramna, Dacca; tel. 283332

België/Belgique: Philips and MBLE associates,
Philips Scientific and Industrial Equipment Division;
80 Rue des Deux Gares; 1070 Bruxelles,
tel. (2) 523.00.00

Bolivia: Industrias Bolivianas Philips S.A.,
Cajón Postal 2964. La Paz;
tel.: 50029/55270/55604

Brasil: Philips Do Brasil Ltda,
Avenida 9 de Julho 5229; Caixa Postal 8681;
CEP 01407 - Sao Paulo (S.P.);
tel. 2825722
Service Centre:
Sistemas Profissionais
Rua Amador Bueno, 474,
Caixa Postal 3159 - S. Amaro
CEP 04752 - Sto Amara (S.P.);
tel. (11) 2476522

Canada: Philips Test and Measuring Instruments Inc.,
6 Leswyn Road,
Toronto (Ontario) M6A-1K2;
tel. (416) 789-7188

Chile: Philips Chiléna S.A.,
Division Professional, Avda. Santa Maria 0760;
Casilla Postal 2687, Santiago de Chile; tel. 770038

Colombia: Industrias Philips de Columbia S.A.,
Calle 13 no. 51–39, Apartado Aereo 4282,
Bogota; tel. 2600600

Danmark: Philips Elektronik-Systemer A/S,
Afd. for Industri og Forskning; Strandlodsvej 4,
P.O. Box 1919, 2300 København S,
tel. (1) 572222

Deutschland (Bundesrepublik): Philips GmbH,
Unternehmensbereich Elektronik für
Wissenschaft und Industrie, Miramstrasse 87,
Postfach 310 320; 35 Kassel-Bettenhausen;
tel. (561) 5010

Ecuador: Philips Ecuador S.A.,
Casilla 343, Quito; tel. 239080

Egypt: Resident Delegate Office of Philips Industries,
5 Sherif Street, Corner Eloui. P.O. Box 1687, Cairo;
tel. 754118/754259/754077.

Eire: Philips Electrical (Ireland) Ltd.
Newstead, Clonskeagh, Dublin 14; tel. (1) 693355

España: Philips Ibérica S.A.E.,
Dpto Aparatos de Medida, Martinez Villergas 2,
Apartado 2065, Madrid 27;
tel (1) 4042200
Service Centre:
Dpto Tco. de Instrumentación,
Calle de Albasanz 75, Madrid 17;
tel. (1) 2047100

Ethiopia: Philips Ethiopia (Priv. Ltd. Co.),
Ras Abebe Areguay Avenue,
P.O.B. 2565,
Addis Ababa; tel. 448300

Finland: See Suomi

France: S.A. Philips Industrielle et Commerciale,
Division S&I,
105 Rue de Paris, 93 002 Bobigny;
tel. (1) 8301111

Great Britain: Pye Unicam Ltd., York Street,
Cambridge CB1-2PX, tel. (223) 358866
Service Centre:
Beddington Lane, Croydon, Surrey CR9-4EN;
tel. (1) 6843670

Greece: See Hellas

Hellas: Philips S.A. Hellénique,
54 Avenue Syngrou, P.O. Box 153,
Athens 403; tel. (1) 9215311

Hong Kong: Philips Hong Kong Ltd.,
P.O.B. 2108, St. George's Building, 21st floor,
Hong Kong city; tel. (5) 249246
Service Centre:
Hopewell Centre, 16th floor,
No. 17, Kennedy Road,
Wanchai, Hong Kong;
tel. (5) 283575

India: Peico Electronics & Electricals Ltd.,
S&I Equipment, Shivsagar Estate,
Block "A", Dr. Annie Besant Road,
P.O.B. 6598, Worli, Bombay 4000 18 (WB);
tel. 391431

Indonesia: P.T. Philips Development Corporation,
Jalan Let. Jen Haryone M.T. Kav. 17,
P.O.B. 2287, Jakarta-Selatan; tel. (21) 820808

Iran: Philips Iran Ltd., P.O.B. 1297, Teheran;
tel. 662281/5

Iraq: Philips Iraq W.L.L., Munir Abbas Building,
4th floor; South Gate, P.O. box 5749, Baghdad;
tel. 8880409

Island: Heimilisteaki SF, Saetún 8, Reykjavik;
tel. 24000

Islas Canarias: Philips Ibérica S.A.E.,
Triana 132, Las Palmas, Casilla 39-41,
Santa Cruz de Tenerife

Italia: Philips S.p.A., Sezione S&I/T&M;
Viale Elvezia 2, 20052 Monza; tel. (39) 36351

Japan: See Nippon

Jordan: Philips Delegate Office,
P.O. Box 35268, Amman; tel. 43998

Kenya: Philips (Kenya) Ltd.,
01 Kalou Road, Industrial Area,
P.O.B. 30554, Nairobi; tel. 557999

Kuwait: Delegate Office of Philips Industries,
P.O. Box 3801, Safat, Kuwait; tel. 428678

Lebanon: Philips Middle East S.A.R.L.,
P.O. Box 11670, Beirut, tel. 382300

Malaysia: Philips Malaysia Sdn Bhd.,
Lot 2, Jalan 222, Section 14,
P.O. Box 2163, Petaling Jaya,
Selangor; tel. 574411

México: Philips Mexicana S.A. de C.V.,
Div. Cientifico Industrial, Calle Durango 167,
Apartado Postal 24–328, Mexico 7 (D.F.);
tel. 544-91-99

Morocco: S.A.M.T.E.L.,Casa Bandoeng,
B.P. 10896, Casablanca; tel. 303192

Nederland: Philips Nederland B.V.,
Hoofdgroep PPS, Boschdijk 525, Gebouw VB,
5600 VB Eindhoven; tel. 793333
Service centre :
Technische Service Prof. Aktiviteiten
Hurksestraat 42, Gebouw HBK,
5600 MC Eindhoven; tel. 723094

Ned. Antillen: Philips Antillana N.V.,
Postbus 523, Willemstad, Curaçao;
tel. 37575/37475

New Zealand: Philips Electrical Industries of N.Z. Ltd.,
Scientific and Industrial Equipment Division;
Horlor Street, P.O. Box 2097,
Naenae, Wellington; tel. 678639

Nigeria: Associated Electronic Products (Nigeria) Ltd.,
Ikorodu Road, P.O.B. 1921, Lagos; tel. 900160/61

Nippon: NF Trading Co. Ltd.,
Kirimoto Bldg. 11-2,
Tsunashima Higashi 1 - Chome, Kohoku-ku,
Yokohama

Norge: Norsk A.S. Philips,
Industri og Forskning, Essendrops gate 5,
Postboks 5040, Oslo 3; tel. (2) 463890
Service Centre:
Postboks 1 Manglerud, Oslo 6; tel. (2) 336270

Oesterreich: Oesterreichische Philips Industrie GmbH,
Abteilung Industrie Elektronik,
Breitenfurterstrasse 219, A-1230 Wien;
tel. (222)-841611/15.

Pakistan: Philips Electrical Co. of Pakistan Ltd.,
El-Markz, M.A. Jinnach Road, P.O.B. 7101,
Karachi 3; tel. 70071

Paraguay: Philips del Paraguay S.A.,
Casilla de Correo 605, Asunción;
tel. 48045/46919

Perú: Philips Peruana S.A.,
Av. Alfonso Ugarte 1268
Apartado Aereo 1841, Lima 100, tel. 326070

Philippines: Philips Industrial Development Inc.,
2246 Pasong Tamo, P.O.B. 911,
Makati Rizal, 3116, Manila; tel. 868951/868959

Portugal: Philips Portuguesa S.A.R.L.,
Av. Eng.º Duarte Pacheco 6, Apartado 1331, Lisboa 1000;
tel. (19) 683121/9
Service Centre:
Servicos Técnicos Profissionais, Outurela,
2795 Linda-a-Velha; tel. (19) 2180071

Saoudi Arabia: Delegate Office Philips Industries,
Sabreen Blgd., Airport Road, P.O. Box 9844,
Riyadh; tel. 4777808/4778463

Schweiz-Suisse-Svizzera: Philips A.G.,
Allmendstrasse 140, Postfach, CH-8027 Zürich;
tel. (1) 4882211/4882629

Singapore: Philips Singapore Private Ltd.,
Lorong 1, Tao Payoh, 1st floor,
P.O. Box 340, Toa Payoh Central Post Office,
Singapore 1231; tel. (2) 538811
Service Centre:
403 Delta House, 4th floor,
No. 2 Alexandra Road,
Singapore 0315; tel. 2712555

South Africa: South African Philips (Pty) Ltd.,
2 Herb Street, New Doornfontein, P.O.B. 7703,
Johannesburg 2000; tel. (11) 6140411

South-Korea: Philips Electronics (Korea) Ltd.,
P.O. Box 3680, Seoul; tel. 794 4202

Suomi: Oy Philips Ab.,
Kaivokatu 8,
P.O. Box 10255,
00101 Helsinki 10; tel. 17271
Service Centre:
P.O. Box 11, SF-02631 Espoo 63;
tel. (0) 523122

Sverige: Svenska A.B. Philips,
Philips Industrielektronik, Lidingövägen 50,
Fack, S11584 Stockholm; tel. (8) 635000

Syria: Philips Moyen-Orient S.A., Rue Fardoss 79,
Immeuble Kassas and Sadate, B.P. 2442, Damas,
tel. 118605/221650/228003

Taiwan: Philips Taiwan Ltd.,
San Min Building, P.O. Box 22978, Taipei;
tel. (2) 5631717

Tanzania: Philips (Tanzania) Ltd.,
Box. 20104, Dar es Salaam; tel. 29571/4

Thailand: Philips Electrical Co. of Thailand Ltd.,
283 Silom Road, P.O. Box 961, Bangkok 5;
tel. 233-6330/9

Tunisia: S.T.I.E.T., 32 bis, Rue Ben Ghedhahem,
Tunis; tel. 244268/243025

Türkiye: Türk Philips Ticaret A.S.,
Posta Kutusu 504, Beyoglu,
Istanbul 1; tel. 435910

United Arab Emirates: Philips Delegate Office,
P.O. Box 2567, Dubai; tel. 220641/220642

Uruguay: Industrias Philips del Uruguay S.A.,
Avda Uruguay 1287, Casilla de Correo 294,
Montevideo; tel. 915641/44

U.S.A.:
Philips Test and Measuring Instruments Inc.,
California, Garden Grove 92645
12882 Valley View Street, Suite 9;
tel. : (213) 594-8741/ (714) 898-5000
California, Milpitas 95035
489 Valley Way;
tel. (408) 946-6722
Florida, Orlanda 32805
750 S Orange Blossom Trail, Suite 206;
tel. (305) 422-8131
Georgia, Norcross 30071
7094 Peachtree Industrial Blvd., Suite 220;
tel. (404) 586-0238
Illinois, Elk Grove Village 60007
175 Scott Street;
tel. (312) 640-7860
Massachusetts, Woburn 01801
21 Olympia Avenue;
tel. (617) 935-3972
Minnesota, Minneapolis 55420
7801 Metro Parkway, Suite 109;
tel. (612) 854-2426
New Jersey, Mahwah 07430
85 McKee Drive;
tel. (201) 529-3800, Toll-free (800) 631-7172

Venezuela: Industrias Venezolanas Philips S.A.,
Apartado Aereo 1167, Caracas 107;
tel. (2) 393811/353533

Zaire:S.A.M.E./S.Z.A.R.L., B.P. 16636, Kinshasa,
tel. 31887/8

Zambia: Philips Electrical Zambia Ltd.,
Mwenbeshi Road, P.O.B. 31878, Lusaka;
tel. 218511/218701

Zimbabwe: Philips Electrical (PVT) Ltd.,
62, Umtali Road, P.O. Box 994, Beverley/Salisbury;
tel. 47211

For information on change of address:
N.V. Philips' Gloeilampenfabrieken,
Test and Measuring Instruments, Building TQ III-4,
5600 MD Eindhoven - The Netherlands

For countries not listed:
N.V. Philips' Gloeilampenfabrieken, S&I Export;
Test and Measuring Instruments , Building TQIII-3,
5600 MD Eindhoven - The Netherlands